SCIENCE ABSTRACTS.

Section A.—PHYSICS.

NOVEMBER, 1932.

GENERAL PHYSICS.

3997. International Metric System of Weights and Measures. *Bureau of Standards, Misc. Publ. No.* 135. [13 *pp*.], 1932.—This publication presents a brief account of the international metric system of weights and measures. Its purpose is to give such information as will adequately answer some of the more simple questions addressed to the bureau on this subject and to set forth a working knowledge of the system. The publication gives a brief account of the origin of the metric system, information concerning the International Bureau of Weights and Measures, the international standards, and the national prototype standards of the United States. A synopsis of the system is given which shows the derivation of the primary units, their interrelation one with another, the method of forming the multiples and submultiples, the abbreviations used, comparisons of the units with those of our customary system of weights and measures and tables of equivalents. The status of the metric system in the United States is shown by congressional enactments and departmental orders.

3998. Convenient Mechanical Means of Winding Quartz Spirals. J. S. Tapp. *Canad. J. of Research*, 6. *pp*. 584–587, *June*, 1932.—A mechanical device has been constructed for the automatic winding of quartz spirals with any desired pitch. The resultant spirals are compact, accurate and uniform, and are produced with a minimum of personal attention. A study was made of the relationship between the sensitivity and the diameter of the fibre employed. The machine itself is inexpensive and involves no complicated parts. About 50 successful spirals have been prepared in the manner recorded. AUTHOR.

3999. Micrometer Levelling Table. J. H. Dowell. *Journ. Sci. Instruments*, 9. *pp*. 234–236, *July*, 1932.—Particulars are supplied and illustrated of the design for a levelling table designed to give precise adjustment in three directions. Because of the high standard of adjustment it is particularly valuable for use as a specimen table for shop and testing-room interferometers. Tests with the table in an interferometer show that all movements are highly sensitive and accurate, a precision of 1″ being obtained for motion in any direction. The construction is robust, and its geometrical design ensures that wear is taken up automatically.
R. S. R.

4000. Air Cushions as Supports for Instruments. E. Gehrcke and B. Voigt. *Zeits. f. techn. Physik*, 13. 8. *pp*. 387–390, 1932.—The arrangement described by the authors [see Abstract 673 (1932)] has been tested when used for supporting a galvanometer, the suspended system of which is exceptionally light and has no air damping. It is thus very sensitive to vibration. It was found that the best results were obtained with air at a pressure of about 90 mm. of mercury, and that other gases were equally effective. J. H. A.

4001. Precision Method for Evaluating Gravity from Photographic Pendulum Observations. B. Gulotta. *Bull. Astronomique,* 7. 4. *pp.* 155–164, 1932.—A method is described claiming to give results ten times more accurate than hitherto obtained, *e.g.*, by the methods of Meinesz or Pacella, for eliminating the error due to inaccurate determination of the time axis, *i.e.*, of the position of rest of the pendulum, and of irregularities due to the mechanism of the chronometer. C. A. S.

4002. Damping of Pendulums Immersed in a Viscous Fluid. E. Tyler. *Phil. Mag.* 13. *pp.* 1099–1128, *June,* 1932.—It has been shown [see Abstract 2135 (1931)] that when an aerofoil pendulum is immersed in a fluid, the damping experienced is mainly influenced by the immersed area perpendicular to the direction in which the vibration takes place. Now theoretical and practical examination is made of the free damping of short cylinders and plates in various liquids at rest, and in a stream of water. In the latter case, observation is made of the amplitude of maintained vibration of the cylinders under the influence of the eddies formed at resonance with the system. The drag coefficients for the cylinders are deduced and the net circulation is found to be 0·13 of that in a single detached eddy. H. M. B.

4003. Elastic Suspension of Pendulums. J. Haag. *Comptes Rendus,* 194. *pp.* 2021–2023, *June* 6, 1932.—The theory developed in a previous paper [see Abstract 16 (1930)] is extended to include the case of a non-uniform plane, *e.g.*, the Holweck–Lejay pendulum. Perturbations of the second order associated with variations of temperature, of g, and with the weight and inertia of the plane are discussed. J. S. G. T.

4004. Surface Tension of Strong Binary Electrolytes. S. Oka. *Phys. Math. Soc., Japan, Proc.* 14. *pp.* 233–252, *May,* 1932. *In German.*—Mathematical. Dilute solutions only are considered and these are assumed to be completely dissociated. The Debye–Hückel interionic theory is applied to the evaluation of the change in surface tension, $\Delta\sigma$, due to the presence of the ions. This change, with the assumptions made, arises solely from the work of separation of the ions in extending the liquid surface. $\Delta\sigma$ is found equal to $Ne^2z^2\gamma/4000D$, where N is Loschmidt's number, e the elementary charge, z the valency of the ions, γ the concentration (gm.-mol./l.) and D the dielectric constant of the solvent. Good agreement with the theory is shown by a number of sulphates of bivalent metals. L. V. C.

4005. Surface Tension Measurement. A. Ferguson and S. J. Kennedy. *Phys. Soc., Proc.* 44. *pp.* 511–519; *Disc.,* 519–520, *July* 1, 1932. —The first part of this paper deals with a method for the accurate determination of the surface tension of liquids available in volumes of not more than one or two cubic millimetres. The method described does not involve any knowledge of the density of the liquid. The second part of the paper describes a series of measurements of the variation with

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concentration of the surface tension of aqueous solutions of *p*-toluidine. Here, also, the method employed is independent of a knowledge of the density of the solution. AUTHORS.

4006. Variation of Surface Tension with Time. J. C. Ghosh and M. C. Nath. *J. Phys. Chem.* 36. *pp.* 1882–1927, *July*, 1932.—The surface tensions of a number of solutions of organic materials are measured at intervals of time, by an apparatus in which a ring is pulled away from but does not break the surface. Most solutions show a variation of surface tension, generally a decrease as time proceeds. The solutions may be divided into three classes: (*a*) true solutions of simple molecules with fairly large velocities of diffusion; the equilibrium concentration at the surface is attained too rapidly for observation in this case; (*b*) solutions of multimolecular aggregates with small velocities of diffusion; and (*c*) colloidal solutions, which give a slow change of surface tension. Hypotheses relating to the kinetics of the (*b*) class are suggested. J. P. A.

4007. Capillary Rise of Liquids between Parallel Plates. S. Ray. *Kolloid Zeits.* 59. *pp.* 280–283, *June*, 1932.—Schultze's results [see Abstract 1813 (1932)] are explained in the light of the author's colloidal theory of surface tension. [See also Srivastava, Abstract 3676 (1931).] T. H. P.

4008. Molecular Area and Volume in Films: Application to Determination of Molecular Area. D. G. Dervichian. *Comptes Rendus,* 194. *pp.* 2129–2131, *June* 13, *and pp.* 2294–2296, *June* 27, 1932.—Further analogies between the FA/F curves (F surface pressure, A area of film) of monomolecular films of myristic acid, etc., and the gas curve (PV/P) based on existing data [see Abstracts 1199 (1926) and 367 (1930)] are pointed out, and, using terms used in regard to gases in analogous senses, it is deduced that at the "vaporisation point" the thickness of film, measured as V/A (V volume of film) is $V^{1/3}$, but at the "saturation point" the area has decreased and V/A is now equal to the length of the molecule as determined by X-ray measurements. Deviations from the film thickness in the former case being exactly $V^{1/3}$ are due to the orienting effect of the liquid surface. The molecular mass of the film substance, M, is $d(SRT/S'P)^{3/2}/N^{1/2}$, where S is the area of the film at the vaporisation point, S′ the corresponding area when the relation $Ps = RT$ holds, *s* being the surface per gm.-mol., *d* density, and R, T, N and P have their usual meanings. This formula, which gives $M = 190$ for oleic acid, would be useful in microchemical analysis, as 10^{-6} gm. gives a measurable film. C. A. S.

4009. Mechanics of Effervescence. O. Stuhlman, Jr. *Physics,* 2. *pp.* 457–466, *June*, 1932.—Bubbles of gas released in a liquid at depths which are large compared with their diameters burst on reaching the surface and eject droplets of fluid into the air. Bubbles of diameter less than a critical value eject many droplets simultaneously. In the case of bubbles of less than 0·12 cm. dia. in water at 21° C. seven droplets were observed; four droplets were produced when bubbles of less than 0·15 cm. dia. burst in benzene at 22° C. For bubbles of the same diameters, droplets were ejected to maximum heights of 14·0 cm. and 9·0 cm. Bubbles of diameter less than 0·10 cm. eject droplets to heights proportional to the 3/2 power of their radii. Bubbles of diameter greater than the critical values burst with less regularity, but always project larger droplets to lower heights as their diameter increases. This irregularity is attributed to instability of the rising bubble. The height distribution, h, of droplets ejected at any single explosion varies with the number, n, of the droplets so that log h decreases proportionally with increase of n. The distribution of droplets at a definite height is approximately Maxwellian. The bursting bubble is accompanied by a gas vortex ring ejection, which assists in raising a liquid jet and in stretching it until it breaks into the exponentially distributed droplets referred to. This exponential drop distribution, integrated with respect to the integral number of drops, showed that the reconstructed jet had the form $hx^2 = \text{const.}$, x denoting the diameter of the jet at height h. The jets investigated by Worthington were the same in character as those now investigated, although produced by the reaction of a falling drop on a liquid surface. J. S. G. T.

4010. Properties of Porous Building Materials. Part V. E. Madgwick. *Phil. Mag.* 14. *pp.* 180–191, *July*, 1932.—Discusses in detail the application of the laws developed in previous papers [see Abstract 2667 (1932)] to the case of a wall with a thin coating of such a material as size, distemper, or paint. Suitable apparatus for measuring the absorption is also mentioned. J. H. A.

4011. Influence of a Solid Wall on the State of Aggregation of a Liquid. M. Reiner. *Phys. Zeits.* 33. *pp.* 499–502, *July* 1, 1932.—A mathematical method is given, whereby from viscosity measurements with capillary tubes of different diameters the influence of the capillary wall on the state of aggregation of the liquid in the boundary layer can be established. If ϵ be the thickness of the latter, Φ its fluidity and ϕ that of the liquid, then the " fictive " fluidity is $\phi' = \Phi - (\Phi - \phi)\left(1 - \frac{\epsilon}{R}\right)^4$, where R is the radius of the capillary tube. H. H. Ho.

4012. Internal Friction and Density in Flames. A. Becker and K. Vogt. *Ann. d. Physik*, 14. 3. *pp.* 241–258, *July* 20, 1932.—The paper describes experiments and gives results obtained in an investigation undertaken to bring a former paper by A. Becker [see Abstract 643 (1908)] up to date in light of new knowledge obtained since 1907 in the technique of flames and in the sphere of hydrodynamics. In the 1907 paper Becker obtained the value of the internal friction and density of a flame from the hydrodynamic resistance. The authors give the newer formulæ for the resistance of a sphere and thin circular cylinder and show how these can be used to determine the internal friction and density, the cylinder being the simpler to use for reasons detailed in the paper. A diagram of the arrangement of apparatus is given. The impulse of the flame on the small cylinder (a piece of thin platinum wire or a piece of quartz fibre) being measured by a torsion wire. The method of measuring the flame temperature and the temperature of the cylinders used is fully described. The values obtained are tabulated for four flames of different composition and temperatures ranging from 1519° to 1926° Abs. In an added note the authors give briefly the results of measurements of the variation in the temperature of the flame near the cylinder or sphere. Finally, they suggest that the method can well be used to determine the absorption and emissive powers of bodies at high temperatures. T. B.

4013. Movement of Viscous Incompressible Liquids. A. Rosenblatt. *Comptes Rendus*, 194. *pp.* 2284–2286, *June* 27, 1932.—Investigates mathematically the conditions under which a viscous incompressible liquid moving between two walls becomes turbulent. E. E. F. d'A.

4014. Intrinsic Forms of the Laws of Plane Motion (Permanent Motion). P. E. Mercier. *Comptes Rendus*, 194. *pp.* 2122–2124, *June* 13, 1932.—A series of elements and their trajectories constitute a curvilinear orthogonal network. For each point of the network the values of ψ, the curvature of the element at the point considered, and ϕ, the curvature of the orthogonal trajectory, can be defined. The laws of hydrodynamics with and without viscosity can be expressed simply as functions of ψ and ϕ and their partial derivatives near the point along the element of arc and the trajectory. The conditions for orthogonality for the system are set out and expressions obtained which allow an analysis from the physical point of view of the classical expressions of viscous forces. Finally, values of ψ and ϕ are obtained in terms of the potential of the curvature of the network. R. S. R.

4015. Discontinuous Fluid Motion under Different Thermal Conditions. S. K. Banerji and V. M. Ghatage. *Indian Journ. Phys.* 7. *pp.* 165–288, *July*, 1932.—Prandtl has shown that a surface of discontinuity in a fluid is unstable; that it develops into waves which finally become three-dimensional vortices. An experimental investigation is described of instability of fluid motion due to a discontinuity of fluid density produced by causing the temperature of a cylindrical or rectangular column of water in a large tank to be different from that of adjoining liquid. In addition, the instability due to two streams of water at different temperatures meeting at various angles is investigated. In each case, the surface of discontinuity develops into systems of three-dimensional vortices. The mechanism of production of the vortices, the dependence of their dimensions, vorticity, etc., upon the temperature-difference at the surface of discontinuity, upon the depth of liquid, and the velocities of the infringing streams are investigated experimentally. Instability causes each crest or trough to assume the form of a " breaker," which then rolls round itself. A succession of spiral vortices is thus formed. In the direction of motion, the vortices increase progressively in dimensions and number of convolutions. For very small differences of temperature the vortices have very large diameters. The greater the difference of temperature at the surface of discontinuity, the more rapidly do the vortices develop. The results are interpreted by simple hydrodynamical theory or by that due to Rosenhead. J. S. G. T.

4016. Measurement of the Resistance Offered by a Viscous Medium to the Movement of Bodies. G. Siadbei. *Comptes Rendus*, 194. *pp.* 2023–2026, *June* 6, 1932.—The velocity of spheres of radii 0·02–0·17 cm. in a viscous medium is investigated experimentally. J. S. G. T.

4017. Forces on a Flat Plate Placed in a Jet of Fluid. S. Tomotika. *Phys. Math. Soc., Japan, Proc.* 14. *pp.* 263–291, *June*, 1932.—In this paper, the flow of an incompressible perfect fluid around a flat plate placed in a two-dimensional jet with finite width is investigated in a general manner and the forces experienced by the plate are calculated rigorously, along similar lines to Cisotti's argument for the case of a flat plate in an unlimited stream. It is shown that the total fluid pressure on the plate is perpendicular to its face. The result is quite natural and is well consistent with the fundamental property of a perfect fluid that it exerts in general only normal pressure on every elementary portion of the surface of a body immersed in it, since the plate has a zero thickness.

AUTHOR.

4018. Forces on a Solid Body Placed in a Jet of Fluid. S. Tomotika. *Phys. Math. Soc., Japan, Proc.* 14. *pp.* 311–340, *July*, 1932.—The expressions for the forces acting on a body placed in a two-dimensional jet of an incompressible perfect fluid are obtained by the principle of momentum, under the assumption that the body under consideration has, on its surface, only some angular points with finite angle, if any, but no cusps at all. The expressions obtained for the forces are quite simple and elegant, and the result is applicable to all bodies having no cusps whatever on their surfaces. The forces which will be experienced by a cylinder with rectangular cross-section placed in a jet of a perfect fluid are then calculated by making use of Blasius' formula and it is shown that the expressions for the forces thus deduced are, as expected, exactly the same as those for the forces acting on any body, obtained in a general manner by employing the principle of momentum. AUTHOR.

4019. Eddy Systems in Plane Turbulent Streaming. F. Magyar. *Zeits. f. angew. Math. u. Mechanik*, 12. *pp.* 157–163, *June*, 1932.—Mathematical. H. F. G.

4020. Behaviour of Eddy Systems. A. Betz. *Zeits. f. angew. Math. u. Mechanik*, 12. *pp.* 164–174, *June*, 1932.—Seven laws are enunciated: (1) In an infinite fluid not subjected to external disturbance the eddies move so that their centres of gravity are unchanged with respect to the boundaries (at infinity) of the fluid; (2) when a fluid exerts a resultant force on its boundaries the centres of gravity of the eddies move in such a manner as to balance this force; (3) an eddy near a plane stationary wall or between two parallel walls moves parallel to the walls; (4) the moment of inertia of the eddy system remains constant if the fixed eddies have no moment with regard to the centre of gravity of the system; (5) in an infinite fluid the total rotation of all the eddies is zero; (6) the centres of gravity of two eddy systems having equal but opposed total rotations move parallel to one another with constant velocity; and (7) under the conditions of (6), the algebraic sum of the moments of inertia of the two systems remains constant. Certain practical applications of these laws are given. H. F. G.

4021. Non-Turbulent Régime beyond the Limit of Reynolds Number for Alternating Vortices. C. Camichel, P. Dupin and M. Teissié-Solier. *Comptes Rendus*, 194. *pp.* 1997–1999, *June* 6, 1932.—Flow past a trapezoidal obstacle, with increasing values of Reynolds number, is studied. No discontinuity occurs in the non-turbulent régime adjacent to the obstacle as the Reynolds number passes the critical value.

H. F. G.

4022. Principle of Similitude in Systems under Pressure without Specific Linear Dimensions. C. Camichel and L. Escande. (*Comptes Rendus*, 194. *pp.* 2105–2108, *June* 13, 1932.—The authors discuss the application of Reynolds' criterion for similitude, VD/ν = constant, to two cases of fluid motion, *viz.*, (1) the incidence of a stream of liquid upon a plane arranged in a diametral plane of the channel in which the flow occurs, and (2) the production of secondary turbulence under the conditions of the experimental work done by Crausse and Baubiac [see Abstract 3299 (1931)]. The principle of similitude is shown to hold in both cases. J. S. G. T.

4023. Cylindrical Vortices of Finite Section. J. Rossignol. *Comptes Rendus*, 194. *pp*. 2026–2028, *June* 6, 1932.—A method of successive approximation is discussed for solving the equations occurring in a previous paper [see Abstract 677 (1932)]. J. S. G. T.

4024. Vortices Near Two Straight Parallel Vortices. W. B. Morton. *Roy. Irish Acad., Proc.* 41. *pp*. 1–7, *July*, 1932.—Motion near two vortices of strengths in any ratio and rotating round their " centre of gravity "—an extension of the " vortex-pair " treated by Kelvin—is discussed. The following results are obtained. On both sides of the line joining the vortex-points describe equilateral triangles. Then, as in the case of the vortex-pair of equal strength, the vortices of these triangles are points of relative rest in all cases. They are termed lateral points. There are also points of rest on the line joining the vortices. These are termed collinear points. Their positions are given by an equation of the third degree having three real roots when the vortices have the same direction of rotation and one real root when the rotations are opposite. Points of rest in a two-dimensional field are of two kinds; (*a*) they may be nodes on a stream line, or (*b*) they may be the limit of closed stream loops which have shrunk to a point. With opposite vortices, the lateral points are always nodes, the collinear point a shrunken loop. With vortices rotating in the same direction the lateral points are shrunken loops, and the three collinear points are nodes. J. S. G. T.

4025. Ship Waves: Their Variation with Systematic Changes of Form. T. H. Havelock. *Roy. Soc., Proc.* 136. *pp*. 465–471, *June* 1, 1932.—In continuation of previous work [see Abstract 2232 (1932)] the author discusses mathematically the problem of the effect on the wave profile of replacing a sudden change of form at bow, stern or shoulders of a ship model by a gradual change of slope of the same total amount distributed uniformly over a length of the ship's form. J. S. G. T.

4026. Displacement of Water and the Nature of Waves Produced by Submarine Explosions. J. Ottenheimer. *Comptes Rendus*, 195. *pp*. 203–205, *July* 18, 1932.—In a previous paper [see Abstract 1613 (1926)], the author has shown that the shock-wave produced by a submarine explosion is preceded by a wave which is musical in character. An experimental method for investigating the displacement of the water due to the explosion is briefly described. The explosion is shown to produce a series of undulations, and the musical note referred to is associated with a vibratory disturbance of the water. J. S. G. T.

4027. Self-Rotating Cylinders. L. S. da Rios. *Accad. Lincei, Atti*, 15. *pp*. 952–954, *June* 19, 1932.—A model of a kind of hydraulic wheel, consisting of a cylinder furnished with flanges of curved form which enters into rapid rotation under the influence of a current, and presents a measurable uplift. This contrivance imitates the Magnus electrical effect of a current upon a rotating circular cylinder. It requires no external power to drive it. The action is gyroscopic. A. D.

4028. Flow of Gas at Low Pressure. P. Clausing. *Ann. d. Physik,* 14. 2. *pp.* 129–133, *July* 12, 1932.—Molecular streaming at low pressure through a tube may be considered as a kind of diffusion in which the mean free path of the molecules is equal to the diameter of the tube. From this standpoint the author shows that the intensity of streaming varies between axis and wall. The ratio of the two intensities, namely $\pi/2$, is correctly given by this approximate theory; but the absolute values are too great in the ratio 4 : 3. J. P. A.

4029. Gaede's Experiments on Molecular Flow. P. Clausing. *Ann. d. Physik,* 14. 2. *pp.* 134–138, *July* 12, 1932.—Results of experiments by Gaede on the flow of hydrogen through narrow slits have been thought to conflict with theory. A proper application of the theory has not, however, been made. If this is done, the results of Gaede agree well with the formulæ, provided a slit is assumed rather narrower than that recorded by Gaede. J. P. A.

4030. Diffusion of Mercury Drops on Rolled Tin Foils. F. W. Spiers. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 280–288, *Jan.,* 1932.—Mercury drops placed on rolled tin foils diffuse into elliptical areas forming an amalgam of approximately constant composition containing 11·8 atomic % Hg. The eccentricity of the drops is independent of their size and is constant during growth. The elliptical diffusion is attributed to the rolling of the foils. The crystal structure of the amalgam is hexagonal, the unit cell containing one mercury atom and having the dimensions $a = 3{\cdot}23$ Å. and $c = 3{\cdot}00$ Å. F. J. W.

4031. Diffusion Coefficients of Bromine-Hydrogen, Bromine-Nitrogen, Bromine-Oxygen and Bromine–Carbon Dioxide. J. E. Mackenzie and H. W. Melville. *Roy. Soc. Edinburgh, Proc.* 52. 3. *pp.* 337–344, 1931–1932.—A brief history (with Bibliography) of the earlier work on diffusion is first given, and is followed by a description of the investigation proper. In this, the diffusion of bromine vapour into various gases has been studied by a visual method at 13° C. The results are in fair accord with Jeans' formula which connects the diffusion coefficient with the molecular radii and molecular weights of the gases concerned. There is evidence that the coefficient varies slightly with the composition of the mixture. J. H. A.

4032. Optimum Conditions for the Diffusion of Hydrogen Through Platinum. V. Lombard and C. Eichner. *Comptes Rendus,* 195. *pp.* 322–324, *July* 25, 1932.—Using the apparatus of a previous investigation [see Abstract 3541 (1932)], the experimental data are now recorded for the diffusion of pure dry hydrogen through platinum plates of thickness 0·199, 0·105 and 0·051 mm. respectively, at temperatures varying from 275° to 606° C. and at pressures from 70 to 772 mm. H. H. Ho.

4033. Time-Pressure Characteristics of Various Diffusion and Molecular Pumps. P. J. Mills. *Rev. Sci. Instruments,* 3. *pp.* 309–322, *June,* 1932.—The time-pressure characteristics of twelve commonly used laboratory high-vacuum pumps are investigated. The results indicate that for many laboratory purposes the more elaborate forms of diffusion pumps are unnecessary, being required only when large volumes of gas are to be exhausted or when time is of importance. This conclusion supports that of Hickman and Sandford, but does not support their conclusion that oils are an efficient substitute for mercury where a trap immersed in refrigerant is not desired, especially when working below a pressure of $3 \cdot 5 \times 10^{-4}$ mm. J. S. G. T.

4034. High-Vacuum Pump. G. Mönch. *Phys. Zeits.* 33. *pp.* 447–451, *June* 1, 1932.—Description of a portable high-vacuum air-pump, of the McLeod type, with auxiliary appliances fitted into the case. A. D.

4035. Safety Device for Vacuum Pumps. W. Pupp. *Phys. Zeits.* 33. *pp.* 530–531, *July* 15, 1932.—A description is given of a simple arrangement for preventing damage through the failure of water supply or heating current to vacuum pumps required to run continuously without attention. C. B. A.

4036. Available Range of the Knudsen Manometer. E. Fredlund. *Ann. d. Physik,* 13. 7. *pp.* 802–810, *June* 2, 1932.—The Knudsen absolute manometer is calibrated with air, hydrogen and CO_2, using the familiar device of a gas-pipette to change the pressure by a known amount, the highest pressure being measured on a McLeod gauge. The readings are not independent of the gas, owing to variations in the accommodation coefficient from one gas to another. The readings are found to be accurate until the mean free path is about 10–12 times the distance apart of the plates. J. H. A.

4037. Calibration of a McLeod Gauge in a Vacuum System. K. H. Ramaswamy. *Phil. Mag.* 14. *pp.* 96–99, *July,* 1932.—Full details are given of a method of calibration applicable when the gauge is sealed in a vacuum system. The error is about 2 %. H. F. G.

4038. Crack Formation in a Glass Plate. G. Nishimura and T. Takayama. *Tokyo Univ. Earthquake Research Inst., Bull.* 10. *pp.* 476–489, *June,* 1932. *In English.*—Continuing previous work [see Abstract 310 (1932)], the nature and mode of propagation of cracks formed in a glass plate by pressure of a small steel ball is studied in greater detail. Circular, spiral and radial cracks are described; and the dependence of speed of propagation of radial cracks on load applied to the ball is investigated. Many photographs of the cracks are provided. J. P. A.

4039. Elastic System Subject to Impulse. M. Biot. *Ann. Soc. Sci. de Bruxelles,* 52. *pp.* 49–53, *June* 8, 1932.—By a method involving the use of integral equations, the displacements of a general elastic system when subjected to an impulse of specified type may be investigated. The relative amounts of energy received by each of the normal modes of vibration of the body are found in general terms which involve the idea of " spectral intensity " of the impulse. The effect of a limited train of sinusoidal waves impinging on the system may be investigated by the same method. J. P. A.

4040. Effect of Torsion on Density, Dimensions and Electrical Resistance of Metals. T. Uéda. *Tohoku Univ., Sci. Reports,* 21. *pp.* 193–230, *July,* 1932.—The change of density, dimensions and electrical resistance in Armco iron, Swedish steel, brass, nickel and copper, when twisted by a torsion-testing machine, was measured. The density of iron and steel decreases with twisting and its rate of decrease is considerable up to the yielding point. The length of the specimens increases slightly with the twisting angle, but beyond the yielding point the elongation becomes larger and larger. The electrical resistance increases as the twisting angle increases, and up to the yielding point its rate of increase is very large, this change being quite similar to that of the shearing stress. In the case of copper and brass, these changes are generally similar to those of iron and steel, but in the case of brass the rate of change is very large, and in the case of copper very small. They increase continuously from the beginning of torsion, and no such abrupt change as occurs in iron and steel is observed. In nickel the change is very large at the beginning of torsion, but from this point it increases only slowly. AUTHOR.

4041. Change in Hardness of a Plate Caused by Bending. S. Kokubo. *Tohoku Univ., Sci. Reports,* 21. *pp.* 256–267, *July,* 1932.—The change in hardness of metal plates caused by bending has been measured with a Vickers hardness tester; the materials used were Armco-iron, 0·2 and 0·7 % carbon steels, copper, brass, aluminium, duralumin and magnesium. The hardness-bending curves show that, in cold-rolled specimens, the hardness on the convex side decreases, at first rapidly and afterwards slowly, with an increasing bending of the specimen, while on the concave side it increases slightly, and also that in the annealed specimens, the hardness on the convex side decreases at first rapidly, and after passing through a minimum, increases slightly, with an increasing bending of the specimen, while on the concave side the hardness always increases. These changes in hardness are satisfactorily explained as the combined effect of the applied stress and the work hardening caused by the bending of the specimen. AUTHOR.

4042. Statics of Loaded Rectangular Plates. H. Schmidt. *Zeits. f. angew. Math. u. Mechanik,* 12. *pp.* 142–151, *June,* 1932.—Employing an integration method previously described [see Abstract 2152 (1931)], the problems of a rectangular plate clamped along two parallel edges, free along the other two, and of a plate clamped along all four edges, are dealt with. The accurate solutions for these cases are reduced to the problem of the solution of two singly infinite systems of equations, having a singly infinite number of unknowns. J. P. A.

4043. Equilibrium Position of an Oscillation. M. Schuler. *Zeits. f. angew. Math. u. Mechanik,* 19. *pp.* 152–156, *June,* 1932.—For reasons given in the paper, the usual methods of finding the equilibrium position of an oscillating body from observations of the turning points lead to erroneous results. If, in the case of little or no damping, the body has successive turning points at A, B, C, etc., the average position of the mid-points of AB, BC, etc., is more correctly the equilibrium position. For large damping a similar method is devised, each swing being subdivided, however. The method is elaborated from the point of view of statistical theory. J. P. A.

4044. Torsional Vibrations of Conical Rods. B. Sen. *Indian Phys. Math. J.* 3. *pp.* 97–98, *June,* 1932.—The modes of torsional vibration of a solid conical rod clamped at a distance a from the vertex are shown to be given by the solutions of an equation expressed in Bessel functions. The roots of the equation are all real and can be found. J. P. A.

4045. Longitudinal Vibration of a Bar Excited by Impact of an Elastic Load. M. Ghosh. *Indian Phys. Math. J.* 3. *pp.* 73–79, *June,* 1932.—The longitudinal vibration of a bar struck by a wholly or partly elastic load is discussed mathematically, employing St. Venant's method of treatment. J. S. G. T.

4046. Stability of Thin Strip. H. J. Gough and H. L. Cox. *Roy. Soc., Proc.* 137. *pp.* 145–157, *July*, 1932.—An acceptance test for failure by buckling of thin strip material of the kind employed in aeroplane construction is required. In an attempt to devise such a test, a strip is subjected to shear stress applied along the edges, and the progress of buckling observed. As a test the method is not quite adequate, but the results show that if the effects of initial departure from planity of the strip be allowed for, the buckling loads determined by experiment are in good agreement with values determined theoretically by the method of Southwell [see Abstract 3102 (1932)] and Skan. J. P. A.

4047. New Method of Investigation of Elastic and Plastic Deformation of Polycrystalline Metals. F. Regler. *Phys. Zeits.* 33. *pp.* 435–438, *June* 1, 1932.—Application of conical reflection methods and monochromatic X-rays, particularly to steel, copper and lead. A sensitive measure of tension is afforded by a measurable broadening of the periphery of interference points. The arrangement permits the difference between the deformation of plastic and elastic materials to be studied. F. I. G. R.

4048. Mechanism of Plasticity. N. Seljakow. *Zeits. f. Physik*, 76. 7–8. *pp.* 535–536, *June* 20, 1932.—Pieces of rock-salt were subjected to pressures of 1·5 to 2·0 kg./mm.^{2}, or to bending under water, and Laue diagrams obtained. It appears that, in portions of the crystal which are near the boundaries of the surfaces in which gliding has taken place, a monoclinic lattice arises, as the photographs show. A schematic representation consists of a pile of layers having members showing cubic and monoclinic symmetry. The upper limit for the angle α characteristic of the latter is found to be 1°. F. I. G. R.

4049. Motion of a Deformable Body which Remains Similar to Itself. M. Pascal. *Accad. Lincei, Atti*, 15. *pp.* 871–873, *June* 2, 1932.—N. Abramesco has recently (*Ann. R. Scuola norm. Sup. di Pisa*: *Sc. fis. e mat.*, (2) v. 1, 1932, *pp.* 155–164) dealt with this kinematical problem in its bidimensional form; the author extends it to the tridimensional case. Here he discusses the fundamental formula and certain deductions therefrom. A. D.

4050. Intermittent Movements Corresponding with the Equation of Jacobi Written for the Case of a Single Point. A. Bühl. *Comptes Rendus*, 194. *pp.* 1562–1564, *May* 2, 1932.—Mathematical. [See also following Abstract.] H. F. G.

4051. Intermittent Movements Corresponding with the Equation of Schrödinger Written for the Case of a Single Point. A. Bühl. *Comptes Rendus*, 194. *pp.* 2195–2197, *June* 20, 1932.—Mathematical. [See also preceding Abstract.] H. F. G.

4052. Motion of a Solid Body Around a Fixed Point. D. Wolkowitsch. *Comptes Rendus*, 195. *pp.* 24–25, *July* 4, 1932.—Several cases are considered briefly. H. F. G.

4053. Hamilton's Principal Function. A. W. Conway and A. J. M'Connell. *Roy. Irish Acad., Proc.* 41. *pp.* 18–25, *July*, 1932.—A method is developed for determining Hamilton's principal function when a complete integral of the Hamilton–Jacobi equation for the dynamical system under consideration is known. G. C. McV.

4054. Generalised Galton Board for the Transformation of Functions. F. Bernstein. *Zeits. f. Physik*, 77. 1–2. *pp*. 104–113, *July* 19, 1932.—Galton invented a board for the demonstration of Gauss' theory of errors consisting of spheres falling between nails arranged in the form of Pascal's triangle. The author introduces some modifications which enable hidden periodicities to be found, and a compound curve to be analysed into its constituents. E. E. F. d'A.

4055. Machine for the Graphical Study of Simple Harmonic Motion. T. Soller. *Rev. Sci. Instruments*, 3. *pp*. 352–355, *July*, 1932.—A simple apparatus for compounding two simple harmonic motions is described with diagrams. They may be compounded either in the same direction or at right angles on cards or specially prepared glass plates for use in a lantern. The amplitudes and frequencies can be set to a large number of values, and the phase to any value whatever. Thus all the phenomena typical of such motions can be quickly demonstrated. H. M. B.

4056. Graphical Differentiation with the Prism Derivator and Tangent Plate. J. Picht. *Zeits. f. techn. Physik*, 13. 7. *pp*. 316–319, 1932.—The principle of the prism derivator is briefly described and explained with the help of several diagrams and graphical differentiation with this alone is described. The tangent plate is next described with the help of a diagram, and it is shown how, with the combination of the prism derivator and the tangent plate, differentiation can be performed in a simple graphical way point by point. R. S. R.

4057. Precision Comparison of Calculated and Observed Grating Constants of Crystals. Y. Tu. *Phys. Rev*. 40. *pp*. 662–675, *June* 1, 1932.—A precision comparison of the calculated and observed grating constants of calcite, rock-salt, artificial KCl and diamond crystals is made with calcite as standard. The calculated values are determined from density measurements, while the observed values are calculated from the angles of reflection for the Mo $K\alpha_1$ line obtained by means of a precision double-crystal spectrometer. The value of λ obtained from the calculated grating constant of calcite is used to determine the observed grating constants of the other crystals. Two methods are used in the X-ray measurements, namely, the calcite and the rock-salt methods. The latter consists of measuring the peak position of the beam reflected from the crystal by swinging the ionisation chamber past the beam, with two narrow slits between it and the crystal, ranging in width from 0·04 to 0·08 mm. and separated by a distance of 18 cm. Calculated and observed values of the grating constants of these crystals are found to agree within experimental error, ranging from 0·004 to 0·011 %, showing no evidence of Zwicky's "secondary structure" [see Abstract 2728 (1930)], which he offered as a possible explanation of the discrepancy between X-ray wave-lengths obtained by the crystal method and those by the ruled grating method. Measurements on two quartz crystals showed a decided variation in the internal structure of the crystal, and indicate that quartz is unsuitable for precise wave-length measurements. AUTHOR.

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4058. " Back-Reflected " Laue Interference Pictures. L. Chrobak. *Zeits. f. Krist.* 82. *pp.* 342–347, *June*, 1932.—Experimental details of an arrangement enabling practically any direction to be used in crystal analysis by Laue photographs. F. I. G. R.

4059. New Method of Analysing Crystalline Powders by X-Rays. (Miss) Y. Cauchois. *Comptes Rendus*, 195. *pp.* 228–231, *July* 18, 1932. *J. de Physique et le Radium*, 3. *pp.* 320–336, *July*, 1932.—A previous paper [see Abstract **3296** (1932)] describes a transmission method of using curved crystalline material to provide monochromatic radiation concentrated in a narrow focal zone. This convergent beam can be used with the following advantages for powder analysis: Beams reflected at Bragg angles between 0° and 45° can be measured with accuracy since the good focussing enables sharp images to be obtained; the photographs can be measured up very simply and without the use of comparison marks on the film; and the radiation is monochromatic to a degree which is determined by the width and position of a slit. J. E. R. C.

4060. Reciprocal Lattice-Projecting Ruler and Chart. L. J. B. LaCoste. *Rev. Sci. Instruments*, 3. *pp.* 356–364, *July*, 1932.—A reciprocal lattice is used to interpret the secondary spectra of oscillating crystal photographs. The projection on the lattice is accomplished by means of a ruler, a chart and a T-square. A description and diagram are given; the procedure for interpreting the photographs is followed by the theory of the method. Results are obtained quickly and with an accuracy greater than required for X-ray data. H. M. B.

4061. Lattice Constants of Beryllium. M. C. Neuburger. *Zeits. f. phys. Chem.* 17. *Abt.B.* 4–5. *pp.* 285–292, *June*, 1932.—For the edge-length of the unit cell in pure Be, the author finds $a = 2 \cdot 2680 \pm 0 \cdot 0002$ Å., $c = 3 \cdot 5942 \pm 0 \cdot 0003$ Å., giving $c/a = 1 \cdot 5847$. The calculated density at 20° C. = 1·857. F. I. G. R.

4062. Crystal Lattice of Germanium Sulphide, GeS. W. H. Zachariasen. *Phys. Rev.* 40. *pp.* 917–922, *June* 15, 1932.—The crystal lattice of germanium sulphide, GeS, was examined by means of the Laue method, the powder method and the oscillating-crystal method. The crystals are orthorhombic bipyramidal. The dimensions of the unit cell were found to be: $a = 4 \cdot 29 \pm 0 \cdot 01$ Å., $b = 10 \cdot 42 \pm 0 \cdot 03$ Å., $c = 3 \cdot 64 \pm 0 \cdot 01$ Å. There are four molecules of GeS in the unit cell and the calculated density is 4·24. The space group is $\mathrm{Pb}nm(\mathrm{V}_h^{16})$. The Ge atoms as well as the S atoms are lying in the reflection planes:

$$(uv0)\ (\bar{u},\ \tfrac{1}{2} - v,\ \tfrac{1}{2})\ (u + \tfrac{1}{2},\ \bar{v},\ \tfrac{1}{2})\ (\tfrac{1}{2} - u,\ v + \tfrac{1}{2},\ 0).$$

The values of the four parameters, u_1v_1 for Ge and u_2v_2 for S, were determined on the basis of intensity calculations, the final result being: $u_1 = 0 \cdot 167$ (60°), $u_2 = 0 \cdot 111$ (40°), $b_1 = -0 \cdot 125$ (−45°), $v_2 = 0 \cdot 111$ (40°). The crystal structure can be described as a deformed rock-salt lattice, the deformation being very great in the direction of the *a* axis. The Ge atoms are surrounded by distorted octahedra formed by S atoms. The Ge atom is not lying at the centre of the octahedron, but is displaced towards one of the octahedral faces. The distance from Ge to three of the S atoms in this manner is distinctly smaller than to the three others. The two distances Ge–S are: 2·58 Å. (average of 2·47, 2·64, 2·64) and 2·97 Å.

(average of 2·91, 3·00, 3·00). The closest approach between two S atoms is 3·55 Å. AUTHOR.

4063. Crystal Lattice of Potassium Pyrosulphite, $K_2S_2O_5$, and the Structure of the Pyrosulphite Group. W. H. Zachariasen. *Phys. Rev.* 40. *pp.* 923–935, *June* 15, 1932.—The crystal lattice of $K_2S_2O_5$ was examined in order to determine the structure of the pyrosulphite group. The Laue method and the oscillating-crystal method were used. The dimensions of the monoclinic unit cell were found to be: $a = 6{\cdot}95$ Å., $b = 6{\cdot}19$ Å., $c = 7{\cdot}55$ Å., $\beta = 102° 41'$. The density determination gave 2·34 and corresponds to two molecules $K_2S_2O_5$ in the unit cell. The space group is $P2_1/m(C^2_{2h})$. Two sets of four O atoms are lying in general positions with coordinates $\pm(xyz) \pm (x', \tfrac{1}{2} - y, z)$, while the remaining atoms are all lying in the reflection planes $\pm(u\tfrac{1}{4}v)$. The parameter values corresponding to the sixteen degrees of freedom were determined accurately and uniquely. No other assumptions than those underlying the theory for the diffraction of X-rays by crystals were made. The final parameters are:

	K I	K II	S I	S II	O I	O II	O III
x	0·22	0·65	0·70	0·01	0·07	0·63	0·67
y	0·25	0·25	0·25	0·25	0·06	0·06	0·25
z	0·95	0·67	0·22	0·32	0·24	0·31	0·03

In the lattice the K atoms are surrounded by nine or by seven O atoms at average distances, respectively, of 3·01 Å. and 2·78 Å. The pyrosulphite group can be described as a sulphite group and a sulphur dioxide molecule linked together by an electron pair bond between the two sulphur atoms. The S–S distance is 2·18 Å. and the average S–O distance is 1·46 Å. The atomic arrangement explains the observed cleavage and twinning. AUTHOR.

4064. Formation of Layer Lattices. H. Arnfelt. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 23*b*. 2. *pp.* 1–6, 1932. *In English.*—Petrol coke, heated for 40 hours to different temperatures (maximum about 2250° C.) was investigated by means of focussing cameras, using chiefly Cr K-radiation, to study the process of graphitisation. Some lines appeared sharply, while others broadened. These effects are traced to the formation of the layer lattice, and some other typical substances having this type of structure have been examined. Graphitisation is shown to be merely the slow crystallisation of such a layer lattice. F. I. G. R.

4065. Lattice Dimensions in Copper-Silver Alloys. Helen D. Megaw. *Phil. Mag.* 14. *pp.* 130–142, *July*, 1932.—The spacing is found to vary throughout single crystals at the silver end of the series, showing that equilibrium has not been attained. This effect is not present in alloys annealed at 452° C., nor in members rich in copper. A number of graphs show the relation between spacing and composition for alloys rich in silver and in copper. F. I. G. R.

4066. Lattice Distortion and Carbide Formation in Tungsten Magnet Steels. W. A. Wood and C. Wainwright. *Phil. Mag.* 14. *pp.* 191–198, *July*, 1932.—" Lattice distortion " in this work refers to the permanent irregular displacement of atoms from their normal positions in the lattice, as opposed to regular changes, such as uniform dilatation. It is measured by the change in breadth of a suitable X-ray line. The presence of carbides was also investigated by examining the X-ray spectrum of the steel. The steel studied contained 5·63 % W, 0·64 % C, 0·27 % Mn, 0·23 % Si, 0·17 % Ni, 0·014 % P and 0·007 % S. The specimens were heated in argon to 850° C. and 900° C. and also to 1250° C. This treatment sufficed to "spoil" the first set (in the technical sense), whilst the second set would be "recovered." The normal untreated specimens showed considerable distortion, with practically no carbides, and the same is true of the "recovered" specimens. The spoiled specimens contained two carbides, Fe_4W_2C, and tungsten carbide, but exhibited no lattice distortion. The atomic spacing in the spoiled specimens was 0·33 % less than in the others. These observations are interpreted as showing that the carbon rather than the tungsten atoms are responsible for the distortion. At 900° C. they combine, and so do not re-enter the lattice, unless the temperature is first raised to 1250° C., when conditions are such that they can do so. Tungsten atoms probably replace iron atoms, and so alter the lattice parameter without distorting it. J. H. A.

4067. Nature of the β-Transformation in Copper-Tin Alloys. Part II. H. Imai and M. Hagiya. *Ryojun Coll. Eng., Mem.* 5. *pp.* 77–89, *June,* 1932. *In German.*—This paper continues the work of Part I [see Abstract 299 (1931)] by a kinetic, dilatometric, thermal and resistance study of the β-eutectic of the Cu-Sn alloys. The rapid decrease of resistance (60 %) between 250–350°C. is ascribed to the formation of an intermediate β″-state in the eutectoid transformation, $\beta \rightarrow \beta' \rightarrow \beta'' \rightarrow \alpha + \delta$, since etching tests also indicate profound change. The martensitic needle structure which β-bronze (poor in tin) exhibits when cooled at high temperatures, and which changes at about 450–500°, is ascribed to the intermediate β′-structure. The decomposition of the needle-structure occurs very slowly, and corresponds with the course of the resistance curve. The unstable structures which arise when (α + β)-bronze is cooled in the presence of β-crystals are explained in connection with the step-like decomposition of the β-eutectoid. H. H. Ho.

4068. Stereochemistry of Crystalline Compounds. Part VII. P. Niggli and E. Brandenberger. *Zeits. f. Krist.* 82. *pp.* 210–238, *May,* 1932.—A discussion of the special position occupied by SiO_2 and related complexes upon the occurrence of minerals in the lithosphere. [For Part VI see Abstract 29 (1932).] F. I. G. R.

4069. Stereochemistry of Crystalline Compounds. Part VIII. Geometrical Derivation of the Structure Types AB_3. W. Nowacki. *Zeits. f. Krist.* 82. *pp.* 355–378, *June,* 1932.—The structural types of compounds of the forms AB_3 and A_2B_3 are deduced. [For Part VII see preceding Abstract.] T. H. P.

4070. Stereochemistry of Crystalline Compounds. Part IX. W. Nowacki. *Zeits. f. Krist.* 83. *pp.* 97–112, July, 1932.—The aim is to find distinctive structural types for compounds AB_3 and A_2B_3, using the methods of geometrical analysis. A closed manifold is obtained of which a considerable number of members actually occur. The octahedron is fundamental, and after that come the cube and perhaps the tetrahedron, with certain restrictions upon the enumeration of the corners. An Appendix by **P. Niggli** deals with the notation for constants in lattice types A_nB_m. [For Part VIII see preceding Abstract.] F. I. G. R.

4071. Spinel Structures with and without Variate Atom Equipoints. T. F. W. Barth and E. Posnjak. *Zeits. f. Krist.* 82. *pp.* 325–341, *June,* 1932. *In English.*—There are two spinel structures, one corresponding to the chemical formula XY_2O_4, and another which may be written $YXYO_4$. In the former the ionic positions are: 8 X's at 8 f, 16 Y's at 16 *c*, 32 O's at 32 *b*; and in the latter: 8 Y's at 8 *f*, 8 X's + 8 Y's at 16 *c*, 32 O's at 32 *b*. The first class comprises the compounds $ZnAl_2O_4$, $NiAl_2O_4$, $CoAl_2O_4$, $FeAl_2O_4$, $MnAl_2O_4$, and the second $FeMgFeO_4$, $GaMgGaO_4$, $InMgInO_4$, $MgTiMgO_4$, $FeTiFeO_4$, $ZnSnZnO_4$. [See also Abstract 3325 (1931) and following Abstract.] F. I. G. R.

4072. Magnesium-Gallium Spinel. F. Machatschki. *Zeits. f. Krist.* 82. *pp.* 348–354, *June,* 1932.—In accordance with the work of Barth and Posnjak [see preceding Abstract], the author considers that the arrangement of kations is not that corresponding strictly to structure-theory. Although the kations occupy probably the 8-fold and 16-fold positions irregularly, the gallium ions are present in greater number than would be expected statistically. Some suggestions for this effect are appended.
F. I. G. R.

4073. Structure of Silicon Compounds, Based upon Tetrahedral Atomic Spacing. R. Reinicke. *Zeits. f. Krist.* 82. *pp.* 394–418, *June,* 1932.—An extension, applied to silicon, of the author's earlier work on the diamond [see Abstract 3316 (1931)]. It appears that, as well as Si, the following atoms permit of treatment on a tetrahedral model, O, N, F and Ne. In cristobalite the tetrahedral surfaces are crossed and the insertion of the O tetrahedron allows of differentiation between the α and β phases. The transition between cristobalite and tridymite is considered genetically. The accepted view of Bragg that spheres of O atoms are mainly responsible for the silicate structures is questioned: the influence of Si is taken as dominant. Finally, the passage from the amorphous to the crystalline state is discussed. [See following Abstract.] F. I. G. R.

4074. Geometrical Derivation as an Auxiliary in Structure-Determinations of Cubic Crystal Structures. R. Reinicke. *Zeits. f. Krist.* 82. *pp.* 419–437, *June,* 1932.—The general methods of the paper described in the preceding Abstract are discussed purely formally. The aim is to provide a means of reducing the labour involved in X-ray structural analysis if certain factors are known. Examples are discussed for binary, and then for more complicated, compounds. F. I. G. R.

4075. Crystal Structure of Tetrammino-Platinous Chloride. E. G. Cox. *Chem. Soc., J. pp.* 1912–1920, *June,* 1932.—$[Pt(NH_3)_4]Cl_2 . H_2O$ is tetragonal, with $a : c = 1 : 0{\cdot}562$. X-ray determinations reveal that each Pt atom has four NH_3 neighbours in square array; then, at a greater distance come eight (equidistant) Cl atoms. Again, four coplanar Cl atoms surround each NH_3 group, while each Cl is surrounded by eight NH_3 groups. The structural units are arranged in planes parallel to (001), giving weak negative birefringence. The paper concludes with a discussion of the possible configuration of the type $[PtX_2Y_2]$, and gives preliminary information for $\alpha[Pt(NH_3)_2 . (C_5H_5N)_2]Cl_2$. F. I. G. R.

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4076. Crystal Structure of Rhombic Ammonium Nitrate. C. D. West. *Am. Chem. Soc., J.* 54. *pp.* 2256–2260, *June*, 1932.—The unit cell has *a* $4\cdot92_8$, *b* $5\cdot43_4$, *c* $5\cdot73_2$ Å., and contains 2 molecules, space group V_h^{13}; there are indications of layering in the direction of the *a*-axis perpendicular to the nitrate planes, which are perpendicular to the *b*-axis, thus differing from the layering of KNO_3 [see Abstract 1096 (1932)]. This layering is probably the cause of the strong double refraction. A complete structure is figured. C. A. S.

4077. Crystal Structure of Ferric Chloride. Nora Wooster. *Zeits. f. Krist.* 83. *pp.* 35–41, *July*, 1932. *In English.*—$FeCl_3$ has a rhombohedral lattice with $a = 6\cdot69$ Å., $\alpha = 52° 30'$, or a hexagonal cell with $a = 5\cdot92$ Å. and $c = 17\cdot26$ Å. The number of molecules to the unit cell are two or six respectively. The space group is either C_3^4 or C_{3i}^2, R_3 or $R_{\bar{3}}$, probably the latter. A layer lattice is found, isomorphous with BiI_3. A special method for preparing anhydrous $FeCl_3$ is described. [See also Abstract 4286 (1932).] F. I. G. R.

4078. Structure of Aromatic Disulphides and Diselenides. L. Egartner, F. Halla and R. Schacherl. *Zeits. f. phys. Chem.* 18. *Abt.B.* 2–3. *pp.* 189–198, *July*, 1932.—Crystallographic data, densities, dimensions of the unit cell, space group and piezo-effect are given for the disulphides and diselenides of phenyl and benzyl and for dibenzyl disulphide. In the dibenzyl compounds the parameter of the S or Se atoms and hence their separation is approximately $1\cdot19$ Å., which is greater than in the lattices of the elements themselves; this is regarded as due to the effect of the substituents. The dimensions of the unit cells of the above compounds are discussed in relation to the positions of the molecules and of the ring-planes. T. H. P.

4079. Large-Scale Crystal Structure in Glasses. (Lord) Rayleigh. *Roy. Soc., Proc.* 137. *pp.* 55–61, *July* 1, 1932.—Certain glasses, containing upwards of 80 % of silica, exhibit a weak quasi-crystalline double refraction. The phenomenon also occurs with phosphatic and boracic glasses. J. T.

4080. X-Ray Diffraction by Volcanic Glasses and Ashes. M. Hirata. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers No.* 370. *pp.* 237–244, *July*, 1932. *In English.*—Various glassy rocks and volcanic ashes are examined by X-rays. Two types of diffraction photographs are obtained. From studies of the photographs of the same materials after heat-treatment it is concluded that the water contained in glassy rock is present in a combined state. J. T.

4081. X-Ray Diffraction Photographs of Vegetable and Animal Fibres. W. T. Astbury. *Phot. J.* 72. *pp.* 318–323, *July*, 1932.—The paper gives a brief outline of investigations which have been made on the structure of such things as cellulose, natural silk, human hair, etc. The nature of an X-ray fibre diagram is explained, and the X-ray photographs obtained from stretched hair and rubber are described and interpreted. J. T.

4082. X-Ray Analysis of Crystals of 1 : 4-Cyclohexanediol of Melting Point 139° C. E. Halmöy and O. Hassel. *Zeits. f. phys. Chem.* 17. *Abt.B.* 4–5. *pp.* 258–264, *June*, 1932.—This investigation indicates the space group C_{2h}^5, and that a third of the molecule is centro-symmetrically orientated while the remainder is not. A complete structural determination was found to be impracticable. H. H. Ho

4083. X-Ray Evidence of the Structure of the Furanose and Pyranose Forms of α-Methylmannoside. E. G. Cox and T. H. Goodwin. *Chem. Soc., J. pp.* 1844–1855, *June*, 1932.—On purely chemical grounds the α-methylmannoside, m.p. 193° C., has been assigned a pyranose structure (C_5O-ring) and the form with m.p. 118° a furanose structure (C_4O-ring). The results of an X-ray examination, although not permitting the determination of the position of every atom in crystals of such compounds, show that the molecules of the two compounds have the above ring-structures. They show also that the side-chain of the furanose molecule lies in the same plane approximately as the ring, and that methyl groups, when present, also lie in this plane. T. H. P.

4084. Crystallographic Data of Phenylosazones and Other Sugar Derivatives. V. H. Morris. *Am. Chem. Soc., J.* 54. *pp.* 2843–2846, *July*, 1932.—Optical data are given for the phenylosazones of glucose, galactose, arabinose, xylose and maltose, potassium hydrogen saccharate, fructose methyl phenylosazone, mannose phenylhydrazone, mucic acid, arabinose diphenylhydrazone and cadmium bromide xylonate. H. H. Ho.

4085. X-Ray Measurements on Solid Nitrogen and Oxygen. M. Ruhemann. *Zeits. f. Physik*, 76. 5–6. *pp.* 368–385, *June* 7, 1932.—Apparatus is described by means of which single crystals of substances of low melting point can be prepared and investigated by the rotating-crystal method. A second apparatus allows of investigations of structure between 80° and 16° Abs. with a Debye–Scherrer camera. The following results have been obtained: β-nitrogen (stable above 35° Abs.) crystallises hexagonally, close-packed spheres, two molecules per cell, axes $a = 4\cdot03$ and $c/a = 1\cdot63$. For α-nitrogen (stable below 35° Abs.), the cubic indices attributed by Vegard are, in general, confirmed. Cell-edge $= 5\cdot67$ Å. The two modifications of solid oxygen exhibit only very small differences. The lines observed do not agree with the rhombic cell given by McLennan and Wilhelm. C. B. A.

4086. Possible Type of Electron-Binding on Crystal Surfaces. I. Tamm. *Zeits. f. Physik*, 76. 11–12. *pp.* 849–850, *July* 12, 1932.—If a crystal is conceived as a lattice of periodic potential, an electron can be bound (under certain conditions) to the surface if (*a*) the energy of the electron falls within a certain " forbidden stretch " of the energy spectrum, and (*b*) the potential energy is smaller than the potential energy outside. It is considered that the treatment can be applied to the phenomenon of free-moving photoelectrons in dielectric crystals, and the nature of binding. F. I. G. R.

4087. Relation between Atomic Arrangement in Compounds and the Number of Valence Electrons. W. H. Zachariasen. *Phys. Rev.* 40. *pp.* 914–916, *June* 15, 1932.—The atomic arrangement in compounds and groups $(A_mX_n)^{-p}$, for which $v = n \times 8 + m \times 2$, is discussed, v being the total number of valence electrons per stoichiometric molecule or group. Available experimental data show that in such groups or compounds the atom A is usually displaced away from the centre of the polyhedron formed by the surrounding atoms X. Simple rules for the amount of displacement are given. The interpretation of the observations in terms of the ionic theory and the theory of electron pair bonds is discussed. AUTHOR.

4088. Variations of Inter-Atomic Distances with the Change from the Cubic Face-Centred Arrangement to the Cubic Body-Centred or the Hexagonal Close-Packed Arrangement. H. Perlitz. *Faraday Soc., Trans.* 28. *pp.* 514–518, *June*, 1932.—From an examination of the data for inter-atomic distances of thirteen substances (metallic) at the transition from the cubic face-centred to the cubic body-centred arrangement, it is concluded that such polymorphic transition leads to a decrease of inter-atomic distances by about 2·25 %. Examination of the data for inter-atomic distances of eleven substances (metallic) at the transition from the cubic close-packed to the hexagonal close-packed arrangement indicates that, in this type of polymorphic transition, the variation of inter-atomic distances depends on the axial ratio of the hexagonal lattice, this variation decreasing to zero with the axial ratio approaching 1·633. T. H. P.

4089. Molecular Rotation in the Solid State : Variation of Crystal Structure of Ammonium Nitrate with Temperature. S. B. Hendricks, E. Posnjak and F. C. Kracek. *Am. Chem. Soc., J.* 54. *pp.* 2766–2786, *July*, 1932.—The following results have been obtained for the five low-pressure forms of ammonium nitrate:

Crystal Form.	Interval of Stability. °C.	Unit Cell.				Space Group.
		a	b	c	No. of Mols.	
		A.	A.	A.		
I. Cubic	125·2–169·5	4·40	4·40	4·40	1	—
II. Tetragonal .	84·2–125·2	5·75	5·75	5·00	2	—
III. Rhombic ..	32·3– 84·2	7·06	7·66	5·80	4	V_h^{16}(*Pbnm*)
IV. Rhombic ..	−18–32·3	5·75	5·45	4·96	2	V_h^{13}(*Pmmn*)
V. ?Hexagonal.	below −18	5·75	—	15·9	6	—

Atomic position and detailed structure have been determined for I, III, and IV, and partly for II. II when formed from III reverts to III, but when from I passes directly to IV at 50°; there are indications of two new phases, II′ and IV′ closely similar to II and IV. V is possibly only pseudo-hexagonal; its structure shows no change at −60°, where the specific heat shows a maximum [see Abstract 2910 (1932)]. Its transition to IV at −18° is sluggish and sometimes delayed to −5°. In I the NO_3 groups probably rotate in three orthogonal directions, and the NH_4 groups in all forms [see Abstract 53 (1931)]. C. A. S.

4090. Spacing of Non-Polar Molecules in Crystal Lattices. Atomic Domain of Hydrogen. New Feature of Structure of the Benzene Ring. E. Mack, Jr. *Am. Chem. Soc., J.* 54. *pp.* 2141–2165, *June*, 1932.—The problem of the space gaps between molecules in organic crystals and the interlocking of the molecules in the lattice is discussed, and the question whether the molecular spacing can be accounted for by contact between outlying H atoms is considered. The "size of atomic domain" is defined, and the actual sizes of the H-domain radius in the gaseous and crystalline states are derived empirically. In terms of a probable H-atom size the spacings of the molecules and the symmetry of the lattice are explained for crystalline methane, ethane and hexamethylenetetramine. Consideration of certain aromatic crystal lattices reveals an apparent new feature of structure of the benzene ring, namely, a dome-shaped electronic domain protruding symmetrically from both faces of the flat hexagonal ring. In terms of this dome a stereochemical solution of the spacing of the layers in crystalline graphite is suggested, and in terms of the dome and a constant H-crystal radius of 1·29 Å. explanations are given of the lattice symmetry and molecular spacing of anthracene, naphthalene and benzene. Empirical evidence of collision area, oil films, X-ray examination of liquid aromatics and molecular volume furnish further support for the existence of the dome. T. H. P.

4091. Formation of Very Thin Crystals with Curved Boundaries. L. Kowarski. *Comptes Rendus,* 194. *pp.* 2126–2129, *June* 13, 1932.—The process is described and figured of the growth (by slow volatilisation and condensation on a razor blade) and disappearance of crystals of *p*-toluidine of thickness about 1 μ. C. A. S.

4092. "Fibrillogram" of the Lines of Force of the Process of Crystallisation. T. Huzella. *Zeits. f. Krist.* 83. *pp.* 89–96, *July,* 1932.—Fibrillographic representation is the name proposed for a microscopic method for obtaining impressions of salt-crystal formations, in solutions of organic fibre materials, in the form of lines making an argyrophile fibre-skeleton, this giving a permanent preparation on dissolution of the salt present. With the help of this method the actions of the forces of crystallisation in the tissue culture may be transferred to the organic tissue-growth so as to make living tissue grow in crystalline form. The method is recommended as an aid to crystallographic investigation, especially of border-line problems of inorganic and organic nature. T. H. P.

4093. Transition Point of the Diamond. G. Friedel. *Zeits. f. Krist.* 83. *pp.* 42–55, *July,* 1932. *In French.*—Work on birefringence points to the existence of a transformation at $\theta = 1885° \pm 5°$ at atmospheric pressure. High pressures in the region of crystallisation are considered to raise the temperature to this point. The mechanism of the process is discussed, as well as the transformation into graphite. F. I. G. R.

4094. Rôle of Water in Zeolites. B. Lengyel. *Zeits. f. Physik,* 77. 1–2. *pp.* 133–138, *July* 19, 1932.—X-ray investigations by the author and observations of other workers show that the water in zeolites does not form an essential part of the lattice. The same diffraction patterns are obtained from natural chabasite, chabasite dehydrated at 300° C., and chabasite saturated with mercury. The conclusions are also supported by microscopic examination. J. T.

4095. Plasticity and Resistance to Breaking of Crystals of Rock-Salt Stretched under Water. L. Piatti. *N. Cimento,* 9. *pp.* 102–124, *April,* 1932. *Zeits. f. Physik,* 77. 5–6. *pp.* 401–403, *Aug.* 2, 1932.—An apparatus is described which permits of studying the Joffé effect in crystals of rock-salt, thinning them by solution in a uniform way over a considerable length. The apparatus removes automatically from the

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solvent in a small fraction of a second both pieces of the crystal which result from the breaking, so that direct measurements can be made of the section of the rod at the beginning of the plastic deformation. Systematic observation with the microscope of the pieces of the crystals so broken under water has shown that the behaviour as to slipping or cleavage of the crystal may be considerably different in the various portions of the same crystal. Thus may be justified the failure of relations between the elastic limit, the plastic lengthening and the resistance to fracture. A case is noted in which a rod of rock-salt behaved as if endowed with perfectly plastic extensibility. [See following Abstract.] J. J. S.

4096. Plasticity of Rock-Salt. L. Piatti. *N. Cimento,* 9. *pp.* 180–188, *June,* 1932.—It was shown in a previous paper [see preceding Abstract] that the lengthening of a needle of rock-salt deformed plastically under water by traction frequently develops with time in a rather irregular way. It appears that this fact can be satisfactorily explained by assuming the presence of a non-uniform spatial distribution of the attitude of the rock-salt crystals to plastic deformation. A new proof of this is furnished by the typical behaviour of plastic salt specimens under dry treatment. J. J. S.

4097. Plasticity of Rock-Salt and Sylvine. F. Rinne and W. Hofmann. *Zeits. f. Krist.* 83. *pp.* 56–74, *July,* 1932.—The temperature-range considered is between 20° and 320° C. The method is that of observing the radius r and depth h of a conical impression for various times of application. The curve of h against the logarithm of the time is approximately linear. This curve becomes steeper and shifts towards increasing intercepts on the vertical axis as the temperature is raised. Curves in agreement are found for cubic and two other faces. Sylvine reacts to the tests more markedly than rock-salt. F. I. G. R.

4098. Lateral Radiation and the Nature of the Colouring Substance in Natural Blue Rock-Salt. Marya Kahanowicz. *Zeits. f. Physik,* 76. 5–6. *pp.* 283–292, *June* 7, 1932.—In coloured blue and violet rock-salt the particles outside the lattice are sub-microscopic crystals of diatomic Na, in which molecular absorption and fluorescence play a part. In the crystal without colour the colouring substance is combined in Na complexes and the system Na-NaCl behaves optically as a Rayleigh turbid medium. The transformation of the crystalline particles into colloidal complexes is realised through heating. The radiation curves show that by raising the temperature of the heating in the crystalline Na_2 particles, deformations of the lattice are caused, and in the colloidal Na complexes disintegration into smaller particles. J. J. S.

4099. Colours Due to Artificial Coloration of Crystals and Spherulites. P. Gaubert. *Comptes Rendus,* 194. *pp.* 2222–2224, *June* 20, 1932.—The "accidental" polychroism, in plane polarised light, of colourless crystals coloured by crystallisation from a solution containing dye [see Abstract 1847 (1932)] is due to the non-monochromatism of the dye combined with the birefringence of the crystal. The pleochroism is more intense the shorter the wave-length of the light. This explanation is discussed in regard to several organic crystals, and spherulites (in which some absorption is caused by the narrow spaces between the fibres); it is also applied to some minerals [see Abstract 103 (1930)]. C. A. S.

4100. Structure Sensitivity of the Ultra-Violet Coloration and Excitation of Salt Crystals. H. J. Schröder. *Zeits. f. Physik,* 76. 9–10. *pp.* 608–627, *June* 27, 1932.—A quantitative investigation is described of the influence of temperature and plastic deformation on the optical behaviour and excitation of salt crystals of different origin. The specific highest excitations in the maximum of the absorption band (465 mμ) are independent to a great extent of the unexcited colour intensities but vary with the individual properties of the crystal material and with the previous thermal and mechanical treatment. The diminution of crystal colour by plastic deformation facilitates the determination of sharply defined photochemical elastic limits. H. H. Ho.

4101. Additive Fading of Alkali Halide Crystals. Part II. Ultramicroscopic Diffusion State. E. Rexer. *Zeits. f. Physik,* 76. 11–12. *pp.* 735–755, *July* 12, 1932.—The macroscopic data of Part I [see Abstract 3306 (1931)] for the immigration of alkali metals into alkali halides as the cause of the optical phenomena are now confirmed by ultramicroscopic data for the Na-diffusion into NaCl, which at high temperatures takes place along inner fissures and defects in the crystals, and at a rate dependent on the degree of fineness. The separation of Na-ultramicrons, which occurs on cooling, has been used for rendering visible the ultramicroscopic fissure condition, and their influence on thermal treatment and plastic deformation has been established. Based on the relationships between cleavage plane formation and crystal structure defects, it is shown that the hitherto unknown mechanism of deformation of NaCl by pressure perpendicular to the octahedral plane consists of a cleavage along cube planes. Experiments with other alkali halides show the same fundamental ultramicroscopic phenomena. The employment of salts of different alkali and alkaline earth metals (Li, Na, K, Ca, Sr, Ba) furnishes with their metals, with respect to spectral distribution, the colours of the metallic kation. H. H. Ho.

4102. Ultramicroscopic Observations with Photosensitive Crystals. Part I. K. Schaum and F. Kolb. *Zeits. f. wiss. Phot.* 31. *pp.* 2–31, *June,* 1932.—Methods of illumination and observation of small crystals of light-sensitive substances are described (thickness 1–10μ). Preliminary results are recorded for a number of substances of experiments to find the phenomena most worth studying and the most convenient methods. Attention is given to the character of the individual crystals grown from solutions: colour, presence of metallic ultramicrons before and during illumination, change of colour and brightness, and hence the size of the metallic ultramicrons formed; condition of the crystal after long illumination, distribution of the precipitated metal and hence of the light-sensitivity, influence of the surrounding medium and of the adsorbed substances. Silver chloride, acetate, iodide, oxalate, benzoate and tartrate were briefly examined and silver bromide more thoroughly. Also cuprous and cupric chlorides, mercuric chloride, bromide and iodide, mercurous chloride, thallium iodide, halides and mixed crystals of AgBr + TlBr and AgBr + TlCl, etc. It is concluded that the photolysis is initiated at faults (*lockerstellen*), and especially at corners and surfaces. The results are illustrated by numerous microphotographs. J. E.

4103. Anisotropic Liquids. Part XVI. C. W. Oseen. *Arkiv f. Mat., Astron., och. Fysik, Stockholm,* 23*A*. 3. [12 *pp.*], 1932. *In German.*—This mathematical paper deals with the thermodynamic theory of the

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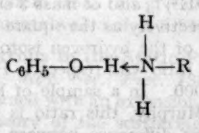
motion of an anisotropic liquid and considers the energy of an anisotropic liquid, equations of motion, more accurate determination of the dissipation function and comparison with the Anzelius theory wherein similarities and divergencies are revealed. A consequence of the new theory is discussed, *viz.*, frictionless motion of an anisotropic liquid alongside its rigid motion. H. H. Ho.

4104. Allotropy in Fluids Part II. A. Smits. Part III. A. Smits and H. Gerding. *Zeits. f. phys. Chem.* 160. *Abt.A.* 3–4. *pp.* 225–244, *June*, 1932.—It is shown in Part II that upon theoretical grounds, even if the substances investigated by Wolfke and Mazur have a transition point in the fluid state, the results obtained have been influenced by the presence of impurities. In Part III a new thermostat is described capable of keeping a temperature constant to 0·0005°. Using this thermostat, nitrobenzene upon dilatometric examination shows no transition point whatsoever in the fluid condition. It is shown that traces of water have probably vitiated all the results obtained by Wolfke and Mazur. It is also pointed out that it cannot be definitely decided that the observed analogous behaviour of ether and CS_2 can be explained on the same grounds. Furthermore, upon examination of acetic acid between 15° and 19° and water between 3° and 5°, no indications are found for a transition point in the fluid state. [For Part I see Abstract 2575 (1931).] J. K.

4105. Parachors and Refractivities of the Molecular Compounds of Phenol. C. A. Buehler, J. H. Wood, D. C. Hull and E. C. Erwin. *Am. Chem. Soc., J.* 54. *pp.* 2398–2405, *June*, 1932.—The molecular organic compounds of phenol, although possessing fairly sharp melting points, decompose so readily into the original components that attempts to gain any information as to their structure by chemical methods have been unsuccessful. In the present investigation two physical methods (parachor and refractivity) have been applied which have involved the measurement of densities, surface tensions and refractivities over a range of temperature. New molecular compounds of phenol have been isolated. A comparison between the observed and calculated values for the parachors and molecular refractions indicates that the bond between the components in the molecular compounds has a negative value. The following electronic formula has been proposed:



$$C_6H_5\text{—}O\text{—}H \leftarrow \underset{\displaystyle H}{\overset{\displaystyle H}{N}}\text{—}R$$

H. H. Ho.

4106. Hume-Rothery Relationship between the Ionisation Potentials of the Elements and their Atomic Numbers. H. Yagoda. *Phil. Mag.* 13. *pp.* 1163–1171, *June*, 1932.—Hume-Rothery has demonstrated that the inter-atomic distance, d, between the atoms in a crystal, is connected with the atomic number, Z_1, of the element, and the total quantum number, n, of its outermost shell of electrons by the equation $d/n = (1/aZ_1)^x$, in which a and x are constants for the members of any one subgroup of the periodic table, provided the coordination number of the atoms remains constant. It follows that n^2V is, approximately, a linear function of $Z^{\frac{1}{2}}$, where V represents the ionisation potential of the atom.

The present paper shows that for neutral atoms the theory is essentially correct, but that a better correlation of the properties of a specific group is given by the equation $n^2V = a \log Z_1 + b$, where a approaches the value 2/3 in the several periodic groups. For singly ionised atoms this latter equation is also valid but the values of a show more marked deviations from the theoretical limit than in the case of neutral atoms. J. S. G. T.

4107. Possible Forces in Mechanical Models of Triatomic Molecules. M. Radakovic. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 1–2. *pp*. 41–54, 1932.—The normal modes of vibration of systems of massive points are worked out usually by assuming one of three systems of forces to bind the atoms together in the molecular model. These systems are (1) the central-force system, in which the points are bound together by forces which are zero in the equilibrium position, and which resist an alteration in the configuration; (2) the valence-force system, in which forces act only along the valence directions, and in addition the equilibrium configuration is maintained by turning moments which resist a change in angles between the valence forces, and (3) Dennison's system, in which the central-force system is supplemented by forces which are not zero in the equilibrium configuration. The case of an isosceles triangle arrangement of three points is investigated, to see what arrangement of forces is possible. It is found that this involves four constants, whereas only three frequencies of vibration are observable. Various supplementary assumptions are made, and it is found that in each case the reduction of the triangle to a linear model results in the linear case of Dennison. A. C. M.

4108. Valence-Force System of Three-Point Masses. F. Lechner. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 3–4. *pp*. 291–302, 1932.—The theory is worked out of the vibrations of three massive points linked together with valence forces, and the vibration frequencies of various molecules are inserted into the theoretical formulæ so as to obtain the values of the forces concerned and the angles between the bonds.
A. C. M.

4109. Search for Isotopes of Hydrogen and Helium. W. Bleakney. *Phys. Rev.* 41. *pp*. 32–38, *July* 1, 1932.—The triatomic hydrogen ion $(H^1H^1H^1)^+$ of mass 3 which is formed at very low pressures by electron impact is separated by the mass spectrograph from the isotopic molecular ion $(H^1H^2)^+$, also of mass 3 since the rates of formation of the two ions vary respectively as the square and the first power of the pressure. The existence of the hydrogen isotope of mass 2 is thus confirmed and its abundance ratio with respect to H^1 in commercial hydrogen is estimated to be 1/30,000. In a sample of hydrogen concentrated by Urey, Brickwedde and Murphy, this ratio is found to be 1/1050. An attempt to detect a mass difference between the ions $(H^1H^1H^1)^+$ and $(H^1H^2)^+$ was unsuccessful, as was also a search for the isotopes He^3 and He^5 of helium. J. E. K.

4110. Relative Abundance of Hydrogen Isotopes in Natural Hydrogen. C. A. Bradley, Jr., and H. C. Urey. *Phys. Rev.* 40. *pp*. 889–890, *June* 15, 1932.—The relative abundances of isotopes have been investigated extensively in recent years, but few researches of such ratios when one isotope is very rare have been reported. We have investigated a number of samples of hydrogen from various sources, water from the crater of Mt. Kilauea, an obsidian, Devonian water and hydrogen

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from helium-bearing natural gases. The spectrographical method used for detection is not free from objections, but the results show that there is no appreciable variation of abundance of H^2 in the samples investigated.
AUTHORS.

4111. Relative Abundances of Nitrogen and Oxygen Isotopes. G. M. Murphy and H. C. Urey. *Phys. Rev.* 41. *pp.* 141–148, *July* 15, 1932.—The absorption spectra of samples of NO were investigated for the purpose of obtaining the relative abundance of the nitrogen and oxygen isotopes. Nitrogen from four different sources was investigated: atmospheric nitrogen, obtained from the Haber and Birkeland-Eyde processes; nitrogen from Pennsylvania coal and from Chili saltpetre. One sample of oxygen was obtained from a pre-Cambrian magnetite. A method has been described for converting the nitrogen and oxygen from these different sources into NO. A method of photographic photometry has been applied to the spectra obtained. The procedure for obtaining the relative abundance of the isotopes is discussed together with the possible sources of error. The average of 32 measurements gives for the ratio of $N^{14}O^{18}/N^{15}O^{16}$ the result $0 \cdot 549 \pm 0 \cdot 007 : 1$. This gives the value 346 : 1 for the ratio N^{14}/N^{15}. The isotopic composition of the four samples of nitrogen and two samples of oxygen is constant within approximately 10 %. **Errata,** *ibid.*, 42. p. 312, Oct. 15, 1932. AUTHORS.

4112. Theory of Electron-Levels in H_2. J. K. L. MacDonald. *Roy. Soc., Proc.* 136. *pp.* 528–537, *June* 1, 1932.—By a variation method based on H_2^+ and atomic H functions the electron energies for 2- and 3-quantum levels in H_2 are calculated. Graphical integrations for a nuclear separation $\rho = 2$ atomic units are employed. Perturbations involving the electron angular momentum and the ρ-variation of the wave functions are evaluated in correlating theoretical and experimental data. The sequence of the levels is the same as that found experimentally and the numerical values of the intervals between combining levels agree with the present interpretation of the experimental material. J. J. S.

4113. Lower Limit for the Ground State of the Helium Atom. D. H. Weinstein. *Phys. Rev.* 40. *pp.* 797–799, *June* 1, 1932.—A method of obtaining a lower limit for the ground state of any system in terms of the energy difference between the ground state and the next highest state is given. Applied to the helium atom this gives a rough value of $-6 \cdot 2$ R, as compared to the experimental value of $-5 \cdot 818$R. AUTHOR.

4114. Motion of Electrons in the Static Fields of Hydrogen and Helium. J. McDougall. *Roy. Soc., Proc.* 136. *pp.* 549–558, *June* 1, 1932.—The author is concerned with an extension of Born's approximation in the wave mechanics theory of the scattering of electrons by atoms. Solutions of the wave equation of the electron are obtained using as potential function the static field of helium (Hartree's data from the self-consistent field) or hydrogen. The solutions corresponding to electron beams with different angular momenta, $\sqrt{l(l+1)}h/2\pi$ (in the model these different electron beams approach to within different distances of the atom, *e.g.*, $l = 0$ represents electrons colliding head-on), pass into simple asymptotic form for large r and the sum of these asymptotic expressions is resolved into a plane wave and a scattered spherical wave. From the scattered intensity the cross-section exposed to the incident beam by the scattering system can be derived. The actual calculations made give the asymptotic forms, for $l = 0, 1, 2$ (helium) and for $l = 0$, hydrogen, in each case for electrons of energy from $\frac{1}{4}$ to 340 volts. Comparison of the helium cross-section/electron-energy curves as computed and as obtained experimentally, shows that for slow electrons the actual scattering is much less than that computed. This difference is probably accounted for by exchange effects (inelastic collisions) which are here neglected. W. S. S.

4115. Bohr's Quantum Conditions. A. Klose. *Preuss. Akad. Wiss. Berlin, Ber.* 13. *pp.* 142–165, 1932.—The author takes the Schrödinger radiation function ψ defined by $\psi = \psi_0 \exp. \frac{2\pi i}{h} \cdot W$ where W is the action of the given mechanical system, and lays down the "periodicity condition" that only those motions of the system are concerned with emission of monochromatic radiation for which the function ψ has precisely the same frequencies as the original mechanical (single or multiple periodic) system. This postulate leads at once to the Bohr quantum conditions and hence to the energy values of the Bohr theory. The Schrödinger wave equation is not made use of, the essential point being the introduction of the function ψ subject to the periodicity condition. The energy values of the Bohr theory differ from those of Schrödinger which agree with experiment, and the author investigates the modification of his periodicity condition necessary to give the correct energy values. Such a modification appears to be possible. W. S. S.

4116. Quantum Treatment of Aromatic and Unsaturated Compounds. E. Hückel. *Zeits. f. Physik,* 76. 9–10. *pp.* 628–648, *June* 27, 1932.—Previous work [see Abstract 1112 (1932)] is now extended by similar methods. The comparison of the electronic configurations of various chemical compounds on the one hand with graduations in their chemical behaviour on the other (especially with respect to alkali) appears to show that the processes adopted for the treatment of electronic structures not only enable the different stabilities of compounds to be predicted approximately, but also afford an interpretation of the chemical characteristics of aromatic and unsaturated compounds. The structures treated include condensed ring systems such as naphthalene and anthracene, diphenyl and open chains. H. H. Ho.

4117. Electronic Structures of Polyatomic Molecules and Valence. Part II. General Considerations. R. S. Mulliken. *Phys. Rev.* 41. *pp.* 49–71, *July* 1, 1932.—A description of electronic structures of polyatomic molecules in terms of atomic and molecular orbitals (one-electron orbital wave functions) is suggested, as follows. Unshared electrons are considered as occupying atomic orbitals associated with the various nuclei to which the electrons belong. Shared electrons are described from several points of view, whose simultaneous consideration should give a better understanding of their condition and functions in the molecule. In the first place, they are described, in terms of atomic orbitals, from the point of view of *each nucleus* in the molecule. In the second place, they are described from a unitary molecular point of view, in terms of molecular orbitals. It is pointed out that the chemical evidence which led Lewis to his concept of the electron-pair bond can now all be explained by the quantum theory without the necessity of using such a concept. It is noted that the Heitler-London, Pauling-Slater quantum-mechanical electron-pair bond concept differs markedly from Lewis's, also that it is of more restricted application to chemical data. It is pointed out, in agreement with Hund, that properties of the Heitler–London, Pauling–Slater electron-pair bond which make it useful in dealing with chemical combination are also possessed by the concept of molecular orbitals. For example, the Pauling–Slater criterion that bonds which correspond to a maximum overlapping of atomic orbitals are the strongest is just as characteristic of bonding molecular orbitals as of electron-pair bonds. An electron-pair bond is here interpreted as being little other than two electrons occupying a bonding molecular orbital. Or in general one must say that a set of n electron-pair bonds is interpreted as a set of $2n$ electrons occupying n molecular orbitals, because molecular orbitals are not necessarily localised *between two nuclei* like electron-pair bonds. It is concluded that the essential facts of molecular electronic structure can be qualitatively understood in terms of the mode of description stated in the first paragraph above and of a semi-empirical valence rule (not essentially new) which summarises, in the light of quantum theory, the most important regularities in regard to the types of chemical compounds which are stable. [For Part I see Abstract 3137 (1932).] AUTHOR.

4118. Invariant Formulation of Dirac's Theory of Dispersion. Part III. W. Wessel. *Zeits. f. Physik,* 76. 5–6. *pp.* 337–367, *June* 7, 1932.—The assumptions made in the preceding paper [see Abstract 794 (1932)] to avoid the difficulty of self-energy (the reaction of electric charges on themselves) were obtained by formal considerations. It is here shown that these considerations may be interpreted physically. A critical investigation leads the author to conclude that it is not the charge but the spin momentum which is the important factor. This view is supported by a parallel behaviour of the charge and the spin momentum which is deduced with the help of Dirac mechanics, but can be accounted for only with difficulty on the classical theory. By quantising the field it is possible to avoid the introduction of double quanta. This leads to a plausible ground for introducing complex field quantities, such as have been suggested in connection with zero-point energy. Methods of overcoming other difficulties are also described. The equations of the Heisenberg-Pauli theory are obtained for the emission, absorption and scattering of an atom with one electron. H. L. B.

4119. Dirac Electron in Gravitational Field. Part I. E. Schrödinger. *Congrès International d'Electricité, Paris, Sect.* 1. *Rapport No.* 2. [11 *pp.*] 1932. *Preuss. Akad. Wiss. Berlin, Ber.* 11–12. *pp.* 105–128, 1932.—The basis of the theory consists in the assumption that in a Riemannian manifold with metric $ds^2 = g_{ik}dx^i dx^k$, the g_{ik} can be expressed by means of matrices γ_i such that $\gamma_i\gamma_k + \gamma_k\gamma_i = 2g_{ik}$. It then follows from the fundamental requirements, viz, (*a*) that the g_{ik} must transform like tensors for point-transformations, and (*b*) that all γ_k obtained from each other by multiplication by an arbitrary matrix are equivalent, that certain functions Γ_e must be introduced. The generalisation of Dirac's linear wave equation must then be of the form $\gamma^k\left(\frac{\delta}{\delta x^k} - \Gamma_k\right) = const.\ 1$, so that the Γ_k play the part, formally at least, of the electromagnetic potential in Dirac's theory. It is then shown that *spur* Γ_k is arbitrary, *i.e.*, that the gravitational field does not determine the electromagnetic potential vector, as was to be expected. The second order wave-equation which results from this theory contains a new term involving the scalar curvature of the Riemannian space only. G. C. McV.

4120. Generalised Dirac Wave Equations. L. Infeld. *Phys. Zeits.* 33. *pp.* 475–483, *June* 15, 1932.—On the basis of the " spin-tensor " calculus introduced by Weyl, a generalisation of Dirac's wave-equations to Riemannian manifolds is made. The theory only holds when the metric of the manifold is orthogonal and the components of the fundamental tensor are all numerically equal. The case of free electrons is discussed in some detail. [See also preceding Abstract.] G. C. McV.

4121. Dirac's Wave Equation of the Electron and Geometrical Optics. W. Pauli. *Helv. Phys. Acta,* 5. 3. *pp.* 179–199, *June,* 1932.—A generalisation of the suggestion made by Wentzel and Brillouin for the solution of the Schrödinger wave equation, in order that it may be applied to the treatment of a multi-component wave function, such as occurs in Dirac's theory is discussed. An approximate solution of the equation shows, as was emphasised by Bohr, that the effects respectively due to refraction and to electron spins are of the same order of magnitude. The rays characterising geometrical optics correspond with the paths of point electrons without spin determined in accordance with the principles of classical relativistic mechanics. The case of the uni-dimensional motion of an electron in an uni-directional electric field, and Klein's paradox relating to the frequency of transfer of an electron into a region corresponding to negative mass, are discussed. J. S. G. T.

4122. Heisenberg's Uncertainty Principle and Dirac's Equations. F. Prunier. *R.G.E.* 31. *pp.* 831–834, *June* 18, 1932.—Assuming that de Broglie waves have a physical existence, the author seeks to give a pictorial representation of Heisenberg's uncertainty principle. A hydrodynamical interpretation of Dirac's wave-equations is also put forward. G. C. McV.

4123. Evidence of Space Quantisation of Atoms upon Impact. H. Kuhn and O. Oldenberg. *Phys. Rev.* 41. *pp.* 72–78, *July* 1, 1932.—An interpretation of certain diffuse bands observed in the spectra of metal vapours mixed with rare gases. Two separate maxima on the short wave-length side of the resonance line of the metal are not due to vibrational quanta as in the case of other similar diffuse spectra. Instead they are interpreted as separate electronic levels of the pair of colliding atoms described by space quantisation taking place in the mutual approach. The diffuse structure on the long wave-length side is due to vibrational quanta of molecules. **Errata,** ***ibid.***, **42. p. 312, Oct. 15, 1932.** AUTHORS.

4124. Relativistic Quantum Dynamics of the Many-Body Problem. H. Seyfarth. *Ann. d. Physik,* 14. 3. *pp.* 321–341, *July* 20, 1932.—The author is concerned with the following difficulties in setting up a relativistic-invariant wave equation for the several-body problem; that the conception of proper time for the individual particles fails owing to the wave character of the latter, and that relativistic-invariant forms for the interaction forces within the system appear impossible to obtain. Adopting a generalisation of the method used by Dirac to obtain his relativistic wave equation for a single electron, the author derives a relativistic wave equation for *n* particles, which, however, still appears imperfect. The application of this equation to the problem of the atomic nucleus is discussed. W. S. S.

4125. Problem of n Bodies with Variable Masses. M. Mendes. *Comptes Rendus,* 194. *pp.* 2289–2292, *June* 27, 1932.—Gives some properties of the solutions of the equations of motion of *n* bodies, whose masses vary with the time and attract each other according to the inverse square law. G. C. McV.

4126. Gravitation Considered as Neutral Magnetism Due to Motion of All Matter in Time. A. P. Mathews. *J. Phys. Chem.* 34. *pp.* 1738–1743, *June,* 1932.—Gravitation is conceived as being due to motion of all matter, composed of hydrogen atoms, in a direction parallel to the time axis of space-time. Assuming the velocity is of the order of magnitude of the velocity of certain stars in space, satisfactory values are derived for the gravitational force between two hydrogen atoms and for the value of the constant of gravitation. J. S. G. T.

4127. Geodesics in Einstein's Unified Field Theory. A. Blackwell. *Roy. Soc. Edinburgh, Proc.* 52. 3. *pp.* 327–330, 1931–1932.—It is demonstrated that the metric for the field around the sun, deduced from the field equations of the unified field theory based on parallelism at a distance, gives results for the deflection of light by the sun and for the motion of the perihelion of Mercury, which are widely at variance with the observed values. G. C. McV.

4128. Unitary Theory of Gravitation and Electricity with Absolute Geometrisation. P. Straneo. *Accad. Lincei, Atti,* 15. *pp.* 462–470, *March* 20, 1932.—The author brings together his results [see Abstract 2311 (1932)] in respect to a unitary theory of macroscopic physics, of maximum generality and of extreme simplicity. The papers referred to solve the problem as it was set by Weyl in 1918; the present paper solves the same problem as it was set by Einstein in 1928. One law, absolutely geometrical (expressed by means of the geometrical elements characterising quadridimensional space-time, without the intervention of tensors), governs all the phenomena of macroscopic physics, and contains, as particular limiting cases, precisely Maxwell's electrodynamical equations and also, with a modification as regards the energy of the field, Einstein's gravitation equations. At the end of 1915 Einstein arrived at his famous gravitational equations. These expressed the law of representative quadridimensional space-time, which is supposed to be Riemannian. His fundamental law contained a term, of no divergence, which it remained to specify from physical considerations. Weyl endeavoured to reach a theory of all physical phenomena which should be a generalisation of Einstein's and should comprise the latter as a particular case. Such theory was to comprise the law of electromagnetism. The unitary problem was reduced in the last analysis to that of suitably extending our geometrical conceptions of space-time beyond the original Riemannian scheme. Levi-Civita's notion of transport by parallelism, and the consequent notions of connections of spaces, with their generalisations, formed an instrument for endeavouring to find a particular extension adapted to the physical requirements. But the numerous attempts made in this direction, including the introduction of a hypothetical fifth dimension, have not proved successful. After this Einstein thought in 1928 of setting the problem in a new way; the geometrisation was to be absolute (to the exclusion of all tensors of physical origin); and the space-time was to admit of absolute parallelism, to which our mind is Euclideanly habituated. The author at once considered this outlook promising, but hesitated about the various solutions which Einstein successively proffered. In the meantime Einstein has abandoned this, and opened up an entirely new way which has led him to a unitary theory comprising gravitation and Maxwell's equations. The new scheme is very abstract and remote from our physical mentality; and it is evident, from what Einstein himself says, that it would never have been embarked upon had the problem been found soluble in the wider form by preceding methods. Einstein started from the Euclidean connection $L^{a}_{\mu\nu} = \Omega^{a}_{\mu\nu}$, the torsion-tensor not being subjected to any bond. This tensor is made up of three tensors, irreducible, with respectively 4, 4 and 16 components. The last of these is the one which is conveniently utilised, along with the $g_{\mu\nu}$'s, for the gravitation; the other two, 4 components each, were to serve for the Maxwellians, but on account of their very different structures this was not possible. The author, starting from a more comprehensive space-time connection than Levi-Civita's, has reached a solution of unexpected simplicity. The paper which does not admit of abstracting, being itself extremely terse, summarises his reasoning. He has succeeded because he has annulled the first of Einstein's three components of the torsion tensor in order to import absolute parallelism of the space-time and has brought the divergence of the second, for the Maxwellians, to the perfectly homologous tensor $\left(\frac{\partial\psi_{\mu}}{\partial x^{\nu}} - \frac{\partial\psi_{\nu}}{\partial x^{\mu}}\right)$. [See following Abstract.] A. D.

4129. Unitary Theory. P. Straneo. *Accad. Lincei, Atti,* 15. *pp.* 563–568, *April* 3, 1932.—Shows that the expression for the general energy-tensor can be developed into

$$\left\{\begin{array}{l}(-\,\psi_{a\mu}\psi_{\lambda\nu}g^{a\lambda} + \tfrac{1}{4}\psi_{a\rho}\psi^{\mu a\rho}g_{\mu\nu}) + \tfrac{1}{2}\Delta^{\lambda}_{a\mu}\Delta^{a}_{\lambda\nu} \\ +\,(-\,\Gamma^{\lambda}_{a\mu}\Gamma^{a}_{\lambda\nu} + \tfrac{1}{4}\Gamma^{\lambda}_{a\rho}\Gamma^{a\rho}_{\lambda}g_{\mu\nu}) + \tfrac{1}{2}\Gamma^{\lambda}_{a\mu}\Gamma^{a}_{\lambda\nu}\end{array}\right\} = -\,k\Omega_{\mu\nu}$$

The first two of the four portions on the left-hand side constitute together the electromagnetic energy-tensor of the new theory multiplied by k. The first of these two portions is the ordinary Maxwellian electromagnetic energy-tensor. The third and fourth portions correspond together to the energy-tensor multiplied by k with change of sign. The first two of the four vanish in the absence of electricity, the third vanishes in the absence of matter. But in this case the resultant equations can, like Einstein's classical $G_{\mu\nu} = 0$, present material corpuscles as singularities in the space-time. The tensor $\tfrac{1}{2}\Omega^{\lambda}_{a\mu}\Omega^{a}_{\lambda\nu}$ then expresses, for a space-time in which there are only isolated point-masses, that energy-something of the field which it has been endeavoured to express in terms of the $g_{\mu\nu}$'s by the Einsteinian pseudo-tensor, which has given rise to so much discussion. Here it is tensorially and correctly derived in terms of the new geometrical elements introduced with the connections; it may be called the energy-tensor (of the field) of (pure) gravitation. The second of the four portions is analogous to the fourth as regards the electromagnetic side of the question; it cannot exist alone without the first portion, of equal and contrary divergence, and a suitable gravitation-tensor. The principal characteristics of the new theory are that (1) all the tensors of the space-time are of geometrical nature, and (2) each tensor is measured by its variance from the corresponding tensors (generally zero) of undeformed space-time, pseudo-Euclidean, which we must admit in the absence of all physical phenomena, including gravitation. There is a clear distinction between material and electromagnetic phenomena, which leads to a simple and intuitive geometrical representation of the theory, to be expounded in a later paper. A. D.

4130. Straneo's Unitary Theory. A. de M. Fernandes. *Accad. Lincei, Atti*, 15. *pp.* 797–804, *May* 15, 1932.—The author submits Straneo's theory to a stringent criticism from the point of view of the distinction between co-variance and contra-variance, and contends that it is inadequate. A. D.

4131. Differential Invariants of Relativity Groups. J. le Roux. *Comptes Rendus*, 194. *pp.* 2019–2021, *June* 6, 1932.—In continuation of previous work [see Abstract 1526 (1932)], the author discusses some of the characteristics of the differential invariants of what he terms "relativity groups," derived by considering certain parameters, occurring in the theory of relativity to be variable just as the coordinates are variable, and using their first derivatives as new independent parameters. The theory developed, applied to deduce the relative energy of a system, gives an invariant value of this energy which is independent of the motion of the system of reference. J. S. G. T.

4132. Deformation of Space in the Theory of Relativity. G. Darmois. *Comptes Rendus*, 194. *pp.* 2269–2271, *June* 27, and 195. *pp.* 20–21, *July* 4, 1932.—In a space whose metrical tensor depends on the time, a small element of length will suffer an alteration in its length with lapse of time and change of orientation in the space. If it is assumed that the alteration of length is independent of orientation and that the space is filled with perfect fluid, the metric of the expanding universe found by Lemaître is deduced. The additional condition that space should be Euclidean at each instant leads to the metric for the universe recently put forward by Einstein and de Sitter. [See Abstract 3156 (1932).] G. C. McV.

4133. Constitution of the Ether. J. MacKaye. *Frank. Inst., J.* 214. *pp.* 73–98, *July*, 1932.—It is claimed that the ether consists of highly penetrating radiation and that gravitation is due to a property of matter which consists in reducing the pressure of this radiation in its immediate neighbourhood. G. C. McV.

4134. Apparent Displacement of Stars in the Neighbourhood of the Eclipsed Sun. A. Danjon. *J. de Physique et le Radium*, 3. *pp.* 281–301, *July*, 1932.—The experimental procedure necessary in order to determine accurately the apparent displacement of a star during a solar eclipse, and more especially how error due to a possible difference of scale of the separate photographic records is to be eliminated, are discussed. The method suggested, applied to the several determinations of this apparent displacement, which are here collected together, gives the following results: Greenwich (1919), 2″·06; Lick (1922), 2″·05 and 2″·07; Potsdam (1929), 2″·06. The author adopts the value 2″·06 as the most likely observational value. J. S. G. T.

4135. Relationship of Universal Physical Constants. W. M. Bond. *Phys. Soc., Proc.* 44. *pp.* 374–381; *Disc.*, 382, *May* 1, 1932.—Eddington's theoretical predictions of the values of the fine structure constant of the ratio of the masses of proton and electron and of the cosmical constant are reviewed. The experimental values of these quantities are discussed and the agreement with the theoretical values is shown to be close. G. C. McV.

4136. Condensations in an Expanding Universe. G. C. McVittie. *Roy. Astron. Soc., M.N.* 92. *pp.* 500–518, *April*, 1932.—The theory is developed of expanding or contracting universes which contain a non-uniform spherically symmetric distribution of mass about a point and in which the pressure is isotropic. Internal and external solutions of the gravitational equations are found, according as the density of the condensation at the point considered, or the total mass of the condensation, is the determining factor in the equilibrium. When applied to the actual universe, it is found that these solutions could only apply to the initial stages of the formation of a nebula, when the expansion of the universe was much slower than it is at present. The calculations lead to a smaller radius for the initial stages of a spiral nebula of average mass, and also to a shorter time-scale for the development of the nebula, than those derived from the theory of Jeans. G. C. McV.

4137. Radiation in an Expanding Universe. N. R. Sen. *Indian Phys. Math. J.* 3. *pp.* 89–95, *June*, 1932.—Two laws are assumed for the conversion of matter into radiation and the conditions are determined that this conversion should give rise to a contraction or an expansion of the universe. G. C. McV.

4138. World Structure and the Expansion of the Universe. E. A. Milne. *Nature*, 130. *pp.* 9–10, *July* 2, 1932.—It is demonstrated that a distribution of nebulæ, spherically symmetrical about a point in Euclidean space, which are endowed with random velocities and do not interact with one another, would, at the end of a sufficient length of time, all appear to be receding from the central point with velocities proportional to their distances from it. If this phenomenon is to appear the same to all observers whose systems of reference are obtained from one another by Lorentz transformations, it is possible to deduce that the initial distribution of the nebulæ around the central point had a density proportional to the inverse cube of the distance from that point. G. C. McV.

4139. Rotation of Material Particles in the Evolution of the Universe. E. Sevin. *Comptes Rendus*, 194. *pp.* 2124–2126, *June* 13, 1932.—The author, in studying the evolution of the universe, was led to the result that the radius of the small cap along which a particle is in contact with the ether increases with time and the potential energy of the particle decreases. Expressions are obtained for the energy, kinetic moment and magnetic moment for the rotation of a particle, and these lead to a kinetic moment of $\frac{1}{2}(h/2\pi)$ and a magnetic moment of $eh/4\pi m_0 c$. These facts are sufficient to explain the anomaly of spin. These and earlier results on the origin and nature of the electronic wave account for all facts regarding polarisation recorded in the reflection and diffraction of electrons by crystals. [See Abstract 3011 (1932).] R. S. R.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

4140. Visibility with Saturated Air. W. H. Pick. Occurrence of Fog with Unsaturated Air. S. E. Ashmore. *Roy. Meteorolog. Soc., J.* 58. *pp.* 165–168, *April, and pp.* 271–281; *Disc.,* 281–284, *July,* 1932.—The frequencies of visibilities over various ranges of distance from < 27 yds. to > 31¼ miles are tabulated for Worthy Down and Felixstowe for several hours of the day and night. The results are classified under fog (< 1100 yds.), mist (1100–2200 yds.) and no mist or fog (> 2200 yds.). Worthy Down and Felixstowe have respectively 41 % and 24 % of occasions with relative humidity 100 % but no mist or fog. At Worthy Down fog is almost certain for a dead calm but less so at Felixstowe. No fog or mist occurs at either place with a wind speed > 12 m.p.h. The results confirm those of G. I. Taylor based on Kew data. **Ashmore** using data for Grayshott found (1) a lower percentage of fogs with unsaturated air than for a town station, (2) little connection between unsaturated fogs and wind force, but fogs occur mostly with wind speeds of 1–3 m.p.h., (3) the highest percentage of unsaturated fogs for SSE–SW winds, (4) the percentage of unsaturated fog lower with half covered than overcast skies, (5) a pronounced tendency for fog with unsaturated air to occur with precipitation, especially drizzle, and (6) good visibility can occur with saturated air, but is less frequent than with dry air. In the *Discussion,* **Owens** suggested the action of hygroscopic particles of different kinds in causing fog with unsaturated air and gave the formula holding within certain limits $V = 340 - 69 \log (RH \times N)$, where V = visibility in miles, RH = relative humidity, and N = number of particles per cc. **Bennett** on similar reasoning stated that in many circumstances sufficient hygroscopic particles exist for a considerable amount of condensation to occur when the relative humidity is below saturation. Frequently hygroscopic nuclei are so scarce and nuclei which function only in super-saturated air so numerous that a certain amount of supersaturation is necessary before condensation occurs to a sufficient extent to produce fog. R. S. R.

4141. Visibility at Sea. W. H. Pick. *Roy. Meteorolog. Soc., J.* 58. *pp.* 251–255; *Disc.,* 255–257, *July,* 1932.—The author reports data relating the visibility observed from ships in the North Atlantic, and the air and sea temperatures and the wind force at the time of observation. The North Atlantic appears to be a region of singularly good visibility both in winter and summer. The highest percentages of good visibilities are observed when the air temperature is less than the sea temperature and when the wind velocity is relatively low. Although most cases of fog occur when the air temperature is greater than or equal to the sea temperature, an appreciable number occur in the reverse circumstances, although then the wind is usually light (at least, in summer). This latter result agrees with G. I. Taylor's observation. Including all fogs, however, nearly 50 % of these occur with a wind force of 4 or more (Beaufort scale). W. S. S.

4142. Size and Size-Distribution of Fog Particles. H. G. Houghton. *Physics,* 2. *pp.* 467–475, *June,* 1932.—An apparatus for the microscopic measurement of fog particles is described. The particles were collected on a slightly greased glass slide and viewed with the aid of dark-field illumination. The particle sizes were measured either visually with an eyepiece micrometer or, more usually, by the subsequent measurement of photomicrographs. With the aid of this apparatus a series of fog particle size-distribution curves was obtained. These curves are characterised by a single maximum which always occurs at a particle diameter which is an integral multiple of $3 \cdot 1\ \mu$. The curves approach the axis asymptotically for large particle diameters, but have a definite minimum. An explanation for this minimum on the basis of certain properties of the nuclei of condensation is offered. AUTHOR.

4143. Application of the Optics of Scattering Media to the Illumination of the Atmosphere. P. Gruner. *Helv. Phys. Acta*, 5. 3. *pp*. 145–160, *June*, 1932.—In continuation of previous work [see Abstract 3219 (1932)] an attempt is made, by use of plausible approximations, to deduce a simple formula for calculating the distribution of light intensity of the whole sky, for an ideally clear atmosphere and neglecting multiple scattering. Simple expressions are also obtained for the intensity of a thin homogeneous atmospheric layer such as may be assumed to exist in a turbid atmosphere. C. B. A.

4144. Lunar Diurnal Variation of Atmospheric Temperature at Batavia, 1866–1928. S. Chapman. *Roy. Soc., Proc.* 137. *pp*. 1–24, *July* 1, 1932.—A lunar tide in the earth's atmosphere is indicated by semidiurnal variations of barometric pressure, and since a change of pressure is usually accompanied by a change of temperature, this is investigated from hourly readings taken over 62 years in Batavia. Hollerith computing machines are found invaluable for dealing with the large masses of data. The main difficulty is the elimination of the solar semi-diurnal variation, since it is much larger than the lunar one and of nearly equal period. The mean value of the temperature change for the whole period implies that the lunar tidal changes of pressure occur nearly adiabatically. Rainless days are examined over certain periods to verify results. H. M. B.

4145. Resonance Theory of Semidiurnal Atmospheric Oscillations. G. I. Taylor. *Roy. Meteorolog. Soc., Mem.* 4. *pp*. 43–51, *June*, 1932.—The author refers to a paper by Chapman, Pramanik and Topping regarding oscillations of the atmosphere being identical with those of a sea of uniform depth (h). If $h = 26{,}400$ ft. the relative magnitudes of the different types of waves can be accounted for, but other considerations indicate that $h = 34{,}000$ ft. and 35,200 ft. It is suggested that this discrepancy might be explained if rapid pressure changes take place adiabatically, while semidiurnal changes are more nearly isothermal. In the present paper this theory is shown to be untenable, because the radiation and conduction necessary to produce any appreciable change in the speed of the wave from that appropriate to adiabatic changes would give rise to so much damping that amplification by resonance to the desired extent would be impossible even if the free period of the atmosphere were exactly 12 hours. The desired resonance, in fact, can only be attained if the time taken for an inequality of temperature to be reduced by radiation or conduction in the ratio $e : 1$ is greater than 76 hours. This discrepancy between the calculated free period and 12 hours remains unexplained. [See Abstract 1766 (1930).] R. S. R.

4146. Lag of the Marine Barometer. T. Sano. *Imp. Marine Obs., Kobe, Japan, Mem.* 5. *pp*. 85–102, July, 1932. *In English*.—Mercury barometers of the station and marine types are usually transported in an inverted position. When erected a certain time-lag occurs before the correct pressure is recorded. Experiments made to test these views showed that the lag of barometers of the station and aneroid types was inappreciable, but for those of the marine type it was quite large, amounting to 0·5 hour or more if an accuracy of 0·1 mm. is to be attained. From theoretical considerations it is found that the calculated value of the lag for a marine barometer agrees with the experimental results so far as the dimensions of the narrower part of the glass tube are concerned. The error which may be expected for the instrument with a sudden change of pressure is estimated and it is deduced that small and gradual changes of pressure such as the diurnal or semidiurnal pressure oscillations affect the instrument only very slightly. R. S. R.

4147. Antarctic Meteorology. E. Kidson. *Roy. Meteorolog. Soc., J.* 58. *pp.* 219–226, *July,* 1932.—Among the more important topics to which the author refers are (1) the level of the tropopause; the pressure and temperature gradients being a maximum in winter and spring and cloud observations on Mt. Erebus confirming this, lead to the view that the tropopause is at a great height and has little variation in height; (2) the effective temperature over Antarctic regions not being known until more data from many different stations are provided; (3) the ozone content at high levels may play an important part in the thermal history of the polar atmosphere; (4) pressure waves of temperate latitudes probably extend to beyond the Antarctic Circle, but probably move at different rates; (5) precipitation being almost entirely snow is extremely hard to measure in the high winds and the effect on the thickness and changes in the ice cap are unknown. R. S. R.

4148. Soil Weights Before and After Dispersion. L. B. Olmstead and H. G. Byers. *Science,* 75. *pp.* 672–674, *June* 24, 1932.—It has been noticed that in the quantitative separation of colloidal material from soils, the total weight of the fractions sometimes exceeds the weight of the original sample and the increases of weight have been attributed to combination with water when the colloidal aggregates are broken apart by dispersion and a greater total surface exposed. An experimental test was made by employing samples of three different soils, developed under a wide range of climatic conditions and offering a fair range of physical and chemical characteristics. The results obtained were essentially negative, no appreciable increase of weight resulting from dispersion in water. If the former result had been common and of appreciable magnitude it should have occurred in the soils examined. R. S. R.

4149. Soil Physics in Relation to Meteorology. B. A. Keen. *Roy. Meteorolog. Soc., J.* 58. *pp.* 229–250, *July,* 1932.—A *résumé* is made of soil physics in respect of the atmospheric influence. The properties of soil are very closely related to its moisture, temperature and air supply. The amount and distribution of moisture in the soil are the results of rainfall, evaporation and percolation; the march of soil temperature is directly controlled by insolation and radiation. Changes in the atmosphere affect the composition of the air in the pores of the soil. Moreover, moisture, temperature and atmosphere are not independent variables; for example, changes in moisture content have important and unexpected effects on soil temperature. Diagrams are given to show the method by which moisture is distributed by capillary action. H. M. B.

4150. Eötvös Torsion Balance. D. C. Barton. *Physics*, 3. *pp*. 29–38, *July*, 1932.—The presence of an extra-heavy (or light) body in the sub-surface warps the level surfaces up (down) over the body and the lines of the vertical toward or into (away from) itself. The Eötvös torsion balance consists of a calibrated platinum-iridium torsion wire which supports a beam of negligible weight; a weight is attached to one end of the beam and a second weight is suspended from the other end. Curvature of the level surfaces and curvature of the vertical each produce at the two weights horizontal components of gravity which are respectively equal and opposite in actual but the same in rotational direction. The torque produced by the curvature of the vertical is a function of the difference of the radii of curvature of the level surface in the directions of major and minor curvature. There has been only one slight important improvement of the torsion balance in the past 25 years. There is room for improvement in the avoidance of temperature effects and in speeding up in the time necessary for observation. The mathematics of the torsion balance and of the gravitational effects of simple geometrical bodies is simple and developed. The main field of research with the torsion balance lies mainly in the geological-geophysical field of interpretation, although there are still unsolved problems in the mathematics of interpretation. AUTHOR.

4151. Representation and Calculation of Results of Gravity Surveys with Torsion Balances. A. O. Rankine. *Phys. Soc.*, *Proc*. 44. *pp*. 465–473; *Disc.*, 489–493, *July* 1, 1932.—This paper deals with an alternative and, it is believed, superior method of indicating the functions of the Eötvös torsion balance, and of calculating those quantities, depending upon the distortion of the earth's gravitational field, which the balance measures. Remarks are also made on the representation of these quantities—the so-called gravity-gradient and horizontal directive tendency—and a convenient method is indicated of applying graphically the necessary corrections for the effects of earth's rotation and irregularity of the surface of the ground. AUTHOR.

4152. Observations with a Gravity-Gradiometer. A. O. Rankine. *Phys. Soc., Proc*. 44. *pp*. 474–489; *Disc.*, 489–493, *July* 1, 1932.—This paper gives an account of a series of observations with a Shaw and Lancaster-Jones gravity-gradiometer, during which it was discovered that very persistent, although small, electric charges could be developed on the mica ring forming part of the oscillation-damping system. The origin of these charges has not yet been ascertained precisely, but one of them has been located and measured approximately by suitable manipulation of the instrument. It is shown that such charges, which may persist for weeks, may not arouse suspicion, although in fact they lead to spurious results in the normal use of the instrument. Thus the apparent gravity-gradient determined by an instrument insidiously charged may have errors of magnitude much larger than the true gradient, and errors of direction of many degrees. It is shown that the effect can be effectively eliminated by introducing into the instrument a sufficient quantity of a suitable ionising agent, such as meso-thorium. This precaution, which can be adopted readily in both old and new gradiometers, is proved to result in a notable improvement in the accuracy and reliability of the instrument.
AUTHOR.

4153. Application of the Reflection Seismograph. E. McDermott. *Physics*, 3. *pp*. 39–52, *July*, 1932.—The method, similar to that of echo-sounding, is based on the reflection of seismic waves (produced artificially) at the interface between strata in which their velocity is different, *e.g.*, between soft shale and rock-salt or limestone. The velocity is preliminarily determined, conveniently by placing the seismometer at various depths in a well and firing shots at the surface. The optimum angle of reflection depends on the number and character of reflecting surfaces; in general, small angles are likely to give the best results. Several seismographic records and the geological sections pertinent thereto in oil-producing areas in Texas are given. C. A. S.

4154. Presence of Slow Waves in the Preliminary Phase of Seismograms. G. Agamennone. *Accad. Lincei, Atti*, 15. *pp.* 960–965, *June* 19, 1932.—The author discusses the appearance at the beginning of the seismograms of some earthquakes of certain slow waves whose presence is liable to be masked by the rapid longitudinal waves. Somville and Landsberg have recently noticed these in the records of various earthquakes as if observed for the first time, but the author points out that he gave an account of his observations of such waves in the seismograms of the Calabrian earthquakes of 1905 and 1908. The observed period of these waves varies in different cases; some recorded having a period of 18 sec. and others of 24 sec. The variation may be chiefly due to the difference in the measuring instruments. The nature of these waves is still obscure, and it is suggested that their thorough discussion would throw light on the mechanism of propagation of earthquakes. J. J. S.

4155. Free Oscillations of Strata Excited by Seismic Waves. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 10. *pp.* 273–298, *June*, 1932. *In English.*—The paper forms a continuation of earlier research on the determination of the possible free range of oscillations of strata due to seismic disturbance. In the present case consideration is given to primary seismic waves incident upwards normal to doubly stratified layers residing on the surface of a semi-infinite body. Results obtained by Matuzawa and Imamura regarding the thicknesses, densities and elastic constants of the two upper layers (granite and basaltic) and the bottom layer (ultrabasic) have been employed. It was found that when the primary waves were of a regular harmonic type or of the type of a single shock, the movements on the surface of the ground are oscillatory in complicated forms. Where successive groups of waves are formed due to reflection at each discontinuous surface, the periodicity of successive groups depends on the thickness of the strata and the proper velocities in them. The identification of these types of oscillations is also discussed. [See Abstract 2757 (1930).] R. S. R.

4156. Amplitudes of P- and S-Waves at Different Focal Distances. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 10. *pp.* 299–334, *June*, 1932. *In English.*—Reference is made to results obtained earlier on the propagation of waves in visco-elastic solid bodies [see Abstract 2767 (1932)]. In the present paper the case is considered where P- and S-waves of equal periods are generated from a point in a visco-elastic body and transmitted in all directions to infinity. To cover all cases the generation of waves of a certain distribution in different azimuths as well as latitudes is examined. Two kinds of S- and one of P-waves are found and the distinguishing features of each are described. For every kind of wave transmitted in a solid body with solid frictional damping the main portion of the displacement varies as the inverse of the radial distance from the origin, but the variation for each kind of wave depends on the direction of propagation. When solid friction is allowed for and all periods are alike, the S-waves are more damped than the P-waves because their time of transmission is greater. The results are also generally true when some boundaries cause reflection and refraction of waves, and where the medium of transmission is also varying. R. S. R.

4157. Deformation of a Semi-Infinite Elastic Body Due to Temperature Variation. G. Nishimura. *Tokyo Univ. Earthquake Research Inst., Bull.* 10. *pp.* 335–351, *June,* 1932. *In English.*—An extension is made of the conditions employed in an earlier paper [see Abstract 3669 (1930)]. Using cylindrical coordinates, expressions are obtained for the displacement of a semi-infinite solid due to temperature variation which satisfy completely the equations of heat conduction and the initial and boundary conditions of the solid. Two cases are treated in which the inertia of the solid is (1) neglected, and (2) taken into account. In each case the resulting equations contain the density term in spite of the fact that the inertia term is neglected in one case but not in the other. R. S. R.

4158. Effect of a Spherical Cavity on the Equilibrium of the Gravitating Semi-Infinite Elastic Solid. G. Nishimura and T. Takayama. *Tokyo Univ. Earthquake Research Inst., Bull.* 10. *pp.* 352–383, *June,* 1932. *In English.*—The stress distribution near a spherical cavity has been investigated for two cases, (*a*) a semi-infinite gravitating elastic solid, and (*b*) an infinite elastic solid due to uniform simple shear. The former throws light on the mechanism of the occurrence of an earthquake, and the latter on the effect of a cavity in a semi-infinite gravitating elastic solid under dynamical forces. It was found that (1) the stress distribution near the cavity surface varies with the depth in the cavity and the cavity dimensions, while Poisson's ratio is also effective, (2) the stress at any point on the cavity depends on the depth of its centre from the upper surface of the solid, (3) the rate of increase of stress with depth of cavity varies over its surface and is a maximum at the equator, (4) at the equator of the cavity the stress is compressive and larger than other components at the surface, (5) some components of stress at the top and bottom of the cavity are tensile for a shallow cavity and small Poisson's ratio, but the magnitudes are small, (6) for case (*a*) when the solid is incompressible its interior is maintained in hydrostatic pressure; the stresses on the surface are compressive; and when the cavity is very deep, the stress components on the surface of the cavity are approximately $-(3/2)\rho g z_0$, and (7) for case (*b*) traction is accumulated on the surface of the cavity and the region affected by it has approximately a radius four times that of the cavity. R. S. R.

4159. Periodic Displacements of Continents. N. Stoyko. *Comptes Rendus,* 194. *pp.* 2225–2228, *June* 20, 1932.—Data provided by the time service in various observatories and centralised in Paris indicate a periodic variation of the longitude of observatories. The period shows a mean value of 11·5 years with an amplitude of 0·03–0°·06. This period is practically that of the sunspot period. It is suggested that it may be due to (1) pulsations of the earth considered as an elastic body, or (2) expansion and contraction of the earth's surface due to motion round a central core. **E. Esclangon** compares these results with Wegener's hypothesis of continental drift. He considers that results for a large number of years will be needed to confirm this new conception. He also discusses the connection with the sunspot period and the possibility of a common cause. R. S. R.

4160. Dynamics of Ocean Currents. V. W. Ekman. *Gerlands Beitr. z. Geophys.* 36. 4. *pp.* 385–438, 1932.—The author's former investigations are completely revised. A current is treated as divided into surface, deep, and bottom portions, and full consideration is now given to the influence of acceleration on the rotational effect due to variation in the depth of the ocean and difference of latitude, which are now shown not to be negligible in all cases for the deep portion. It is assumed that friction only results from the horizontal component of the motion. The treatment is mathematical throughout. C. A. S.

4161. Application of Fjeldstad's Method to the Theory of Ocean Currents Produced by Wind. K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 5. *pp.* 52–61, *July*, 1932. *In German.*—Reference is made to Fjeldstad's treatment of ocean currents produced by wind, and the origin of drift currents, under the influence of the earth's rotation for regular and variable frictional coefficients [see Abstract 3060 (1930)]. The author treats the same problem, using Stokes' integration method. An ocean of infinite extent, uniform depth and constant density is assumed, the influence of boundary ocean currents and continents not being considered, while the water is free to move in all directions. Curvature of the earth is neglected. The wind is assumed to be of constant speed and direction over the ocean, but it may be a function of the time. The resulting motion of the water is horizontal, and depends only on the time and the depth of the water. The analysis is somewhat simpler than Fjeldstad's, but there is no essential difference in the results. R. S. R.

4162. Tidal Oscillations in a Circular Basin with an Elevation or a Depression at its Centre. K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 5. *pp.* 63–67, *July*, 1932. *In English.*—To obtain a mathematical solution a circle of discontinuity is employed by which the entire basin is divided into two zones in each of which the depth is uniform. The method may be extended to a basin having n circles of discontinuity which divide the entire basin into $(n + 1)$ zones with different depths. It is found that the period of oscillation in a basin with an elevation appears to be longer than that in a basin of uniform depth, when the mean depth of the former is equal to the depth of the latter. R. S. R.

4163. Oscillations of Water in Spindle-Shaped and Elliptical Basins. H. Arakawa. *Imp. Marine Obs., Kobe, Japan, Mem.* 5. *pp.* 69–83, *July*, 1932. *In English.*—Hidaka has treated the problem [see Abstract 3294 (1931)] assuming for spindle-shaped basins the depth was small comparable with the wave-lengths. The author extends this to the more general case in which the depth is comparable with the wave-lengths and deals also with the motion of water in the interior of the medium. Mathematical relations are established for the period of oscillations, nodal parabolæ, distribution of amplitude, and distribution of velocity in the interior of the medium and at the surface, and finally the effects of viscosity are considered. For an elliptical lake equations of motion are established for the interior, and the surface and the period of oscillation and distribution of velocity are found. R. S. R.

4164. Secondary Undulations in Bays Forming a Coupled System. M. Nakano. *Phys. Math. Soc. Japan, Proc.* 14. *pp.* 372–380, *July,* 1932.—In a pair of bays lying side by side there often occur secondary undulations showing a feature similar to that of beats in acoustics, and on some occasions intermittent vibrations are also observed as in the case of two simple pendulums connected by an elastic spring. A systematic examination of the secondary undulations in about 50 bays on the Japanese coast provided illustrations, while particularly was this the case for Koaziro and Moroiso Bays. The mareograms obtained are shown. A mathematical solution is obtained for the horizontal motion of water across the mouths of bays and for the phenomenon of beats. R. S. R.

4165. Mean Sea Level as a Geophysical Datum. H. A. Marmer. *Am. J. Sci.* 23. *pp.* 35–45, *July,* 1932.—The use of mean sea level (M.S.L.) as a geophysical datum has the advantages of simplicity of definition, accuracy of determination, readiness of correlation and certainty of recovery if all bench marks are lost. The diurnal, monthly and annual fluctuations in sea level are discussed and the effect of variations of wind and weather on them. Although 19 years constitutes a tidal cycle, the M.S.L. at one point can be obtained by comparing the mean for a series of observations of water level with that at an adjacent primary tide station over the same period. The difference of the latter from its M.S.L. being known, that for the required station can be obtained. By comparison with simultaneous observations at a suitable primary station a precision can be obtained of (1) 0·25 ft. from one day's observations, (2) 0·1 ft. from a month's observations, and (3) 0·05 ft. from a year's observations. R. S. R.

4166. Jupiter's North Temperate Belt, and Systematic Errors of Observation. A. S. Williams. *Roy. Astron. Soc., M.N.* 92. *pp.* 836–839, *June,* 1932.—Gives observations of the longitude of features in the North temperate belt of Jupiter for Jan.–May, 1932, from which rotation speeds are derived. Notes that in addition to systematic errors that may characterise the work of different observers, there is a systematic difference in the author's own case between transit observations with the right eye and identical ones with the left. It amounts to 2° of longitude on Jupiter, or 3½ minutes of time, and affects all his work since 1928. R. d'E. A.

4167. Original and Actual Orientation of Minor Planets and Jupiter's Orbits in Relation to Primitive Causes of Their Eccentricities. E. Belot. *Comptes Rendus,* 194. *pp.* 2030–2032, *June* 6, 1932.—An extension of the author's previous work (1908–1921) to the 1152 minor planets catalogued by Fayet. The aphelia of all planets were originally in a plane perpendicular to the ecliptic. Because of his great mass, Jupiter gravitated earlier than the asteroids to the ecliptic plane, and thereby used up the nebulous mass unduly leaving little to the planetary ring x_{10} from which the asteroids come. He compares the orientation of the aphelia and perihelia of the minor planets with those of Jupiter, both showing great concentration on Jupiter. This research is intimately connected with that of the planetary eccentricities, for which he states two principal causes verified in the cases of the moon and Pluto [see Abstract 1840 (1931)]. His theory of asteroidal dispersion shows that the mean densities should increase from Mars to Jupiter, tending to the mean of these two planets (2·59). Thus the total mass of the ring should be 1 : 1831 of the earth's mass. A. S. D. M.

4168. Absorption Band at λ6191 in the Spectrum of Jupiter. C. T. Elvey and A. S. Fairley. *Astrophys. J.* 75. *pp.* 373–378, *June*, 1932.—A photometric study of the absorption band in the spectrum of Jupiter at λ6191 and of the red absorption bands of water shows that the identification by McLennan, Ruedy and Burton [see Abstract 131 (1929)] of the bands of the major planets with those of water is not possible. Also, observations show that the intensity of the band does not increase at the limb of the planet. A contour of the band is given. AUTHORS.

4169. Scarcity of Hyperbolic Comets. J. Bosler. *Comptes Rendus*, 194. *pp.* 2193–2195, *June* 20, 1932.—The author regards the view that the scarcity of hyperbolic comets implies an origin within the solar system as untenable. He assumes that comets come in all directions from infinity, and shows that the number captured and therefore returning must be such that in a comparatively short period the returns of elliptic comets will greatly exceed the number of hyperbolic comets. A numerical illustration is given. T. L. M.

4170. Evolutionary Origin of Solar System. R. Gunn. *Frank. Inst., J.* 213. *pp.* 639–659, *June*, 1932.—The author collects the conclusions of a number of previous papers [see Abstract 1902 (1932)]. He states his reasons for traversing the current view of the rarity of solar systems, and collects the principal regularities of the system; evidence is adduced for a primitive rotation corresponding to that which would break up the sun under centrifugal force. The author believes that the entire system was practically condensed when formed. A summary is given of his work on electromagnetic winds, which are shown to increase the angular velocity of a star until rotationally unstable; subsequent evolution is affected by asymmetrical radiation of mass [see Abstract 2350 (1932)]. While the two components of the resulting double star are closer than the Roche limit, superficial disintegration produces the planets and tidal couples transform rotational to orbital momentum in both planets and component stars; while a planet is still nearly unstable rotationally, satellite formation takes place. The relatively great distances of planets are accounted for by their loss from the receding companion star; this has not affected satellites, which are in relatively condensed systems. The asymmetrical mass radiation has expelled one component to infinity. T. L. M.

4171. Spectroscopic Observations of Sun's Rotation Made at Royal Observatory, Edinburgh, 1914–1931. J. Storey. *Roy. Astron. Soc., M.N.* 92. *pp.* 737–741, *June*, 1932.—The spectroscope is a Rowland concave grating of 21½ ft. radius, the spectrum is of the 3rd order, about λ6300, 1 mm. = 0·72 Å., with a filter to eliminate overlapping orders. The velocity measured is equatorial. The measures were divided into six groups, and the solar displacement was determined differentially from the mean of the near telluric lines so as to obviate inclination of the vertical wire to the spectrum lines. A table gives comparison with Mt. Wilson results, showing almost systematic differences, and the cause of this is not discovered. Large differences of rotation occur from plate to plate and often on the same plate; an instance is given for 9 lines all at low level in the reversing layer, where the first two or three lines individually give rotation values very different from the rest. A. S. D. M.

4172. Observations of Intensities of Solar Spectrum Lines. R. v.d. R. Woolley. *Roy. Astron. Soc., M.N.* 92. *pp.* 806–820, *June*, 1932.—The use of spectrophotometry to obtain stellar temperatures and surface gravities meets many experimental difficulties; the author regards good prism apparatus as superior to gratings here; and gives results with Evershed's liquid-prism spectrograph on the solar spectrum, 4086–4390 Å. Special standardising arrangements are described, and intensities of 108 lines given. A comparison with grating spectra shows that the prism spectra give deeper central intensities and greater total intensities. The following results are discussed: (1) Hδ has a greater intensity in the sun than Hγ; (2) neither line has zero central intensity; (3) very strong Fe multiplets show anomalous intensities; (4) lines of the same total intensity show differences in apparent central intensity. This is discussed and related to the type of absorbing system involved. T. L. M.

4173. Distribution of Intensity of Fraunhofer Lines. Part II. Intensity of Line Wings. A. Unsöld. *Zeits. f. Astrophysik*, 4. *pp.* 339–357, *June* 28, 1932.—Previous discussions of stellar absorption lines have proceeded from Schwarzschild's differential equation for radiative equilibrium. The author employs the corresponding integral equation and takes the case where both scattering and line absorption are less than the continuous absorption and derives an approximate solution using the Neumann series. The absorption on the wings of a Fraunhofer line may be expressed in terms of the intensity of the continuous spectrum as the sum of two integrals of functions representing the contribution of an atom at a given depth in respect of true line absorption and of scattering. The usual assumption that depths below 0·5 continuous absorption may be neglected appears unjustified. The intensity of radiation is computed as a function of the angle at which it leaves the atmosphere. The special cases of the Schuster–Schwarzschild and Milne–Eddington models are discussed in detail. An examination is made as to which characteristics of Fraunhofer lines depend on the relation between scattering and absorption with optical depth (model used), and which depend on whether they arise from scattering or true absorption; the first cause is found much more important. [For Part I see Abstract 3651 (1932).] T. L. M.

4174. Characteristic Features of Solar Prominences. E. Pettit. *Mt. Wilson Observat. Contrib. No.* 451. *Astrophys. J.* 76. *pp.* 9–43, *July*, 1932.—In the flash, lines brighter than 30 on S. A. Mitchell's scale are all found in prominences, and 14 lines fainter than 30; "metallic" prominences show all lines brighter than 15, except ionised Ba. Prominences are of 5 forms; of these the active, eruptive and quiescent ones are in shape like sheets of flame on edge, and all, probably, connected with the chromosphere by columns from this edge. The author gives average dimensions, volumes, densities and mass; as regards mass, Ca is negligible and the average H content is $2 \cdot 10^{13}$ atoms per c.c.; Ca and H prominences are essentially the same in form. The arching of coronal streamers about prominences indicates a field of force. On four days in 1931, the thickness of the chromosphere averaged 5500 km., which is only half that of Mitchell's value from the flash spectrum. The author (corroborated by measurements by (Miss) Ware, Nicholson and Hubble) finds an upward *uniform* motion of prominences modified by sudden increases of velocity; this uniformity is directly opposed by Milne's theory of the effect of light-pressure, but it is confirmed in that eruptive prominences show no separation of atoms of neutral H and ionised Ca as should be according to Milne. He likens the uniform motion of prominences through the corona to a rubber balloon filled with gas lighter than air ascending uniformly in our atmosphere. He finds that the density of the prominence of August 6, 1931, followed the law $d \approx R^{-6}$, and concludes that it was a volume of gas expanding as it rose, so keeping its density in step with the corona. The sudden increases in velocity he attributes to high-speed electrons in the coronal streamers giving impulses to the prominences. Tornado prominences he likens to our desert "dust devils." A. S. D. M.

4175. Use of First Laplacean Error Curve in Stellar Statistics. W. J. Luyten. *Nat. Acad. Sci., Proc.* 18. *pp.* 360–365, *May*, 1932.—Doubt has been thrown on the practical validity of the Gaussian curve in recent work. The author has found the first Laplacean curve more successful in treating a homogeneous series of observational errors (double-star distances), and gives details of the case and methods adopted. T. L. M.

4176. Absolute Personal Equation in Transit Observations. A. Lambert. *Bull. Astronomique,* 7. 4. *pp.* 129–140, 1932.—The author recommends that the absolute personal equation be determined in all accurate work. It is separated into bisection equation (failure to bisect small circular image accurately) and motion equation (due to anticipation of movement by the eye, or the reverse). The author describes with figures a simple apparatus for providing an artificial star in steady motion at desired rate in either sense, and gives formulæ for analysing the absolute personal equation with results for 4 observers. T. L. M.

4177. Visual Binary Orbits: New Analytical Method of Computation. D. Barbier. *Bull. Astronomique,* 7. 4. *pp.* 141–154, 1932.—The author separates e, P, T into one group, a, i, node, and ω into a second. The method then depends on the establishment of a function $\alpha(t)$ from the observations, where $1/a^3 = \dot{\theta}^2 - \ddot{r}/r$ and $1 - e\cos u = n^{\frac{2}{3}}a$, and r, θ are distance and position angle at t (notation otherwise standard). $\dot{\theta}$ is in general sufficiently known, but $\ddot{r}$ may require interpolation from a curve, and in general r must be well known. Details of procedure are given for the cases where $(\alpha)t$ can be found for a whole period, half period or shorter interval. As a numerical example the case of γ Virginis is given.

T. L. M.

4178. Calculation of the Orbit of a Visual Binary. E. Martin. *Accad. Lincei, Atti,* 15. *pp.* 955–960, *June* 19, 1932.—With relation to the determination of the geometrical elements of a visual binary a method of tracing the line of the nodes is described which requires only the knowledge of the apparent ellipse, and that when required, differing from previous methods, can be repeated many times, thus on the average of the resultant directions for the line sought diminishing the uncertainties of the graphical construction. For the calculation of the elements of the true orbit there is also explained a method of proceeding which is simple and for which there is needed only some measurements on the nodal line and on the chord perpendicular to it, whatever may be the method which has served for tracing them. J. J. S.

4179. Variation of Eccentricity and Semi-Axis Major of a Spectroscopic Binary. M. H. H. Walters. *Roy. Astron. Soc., M.N.* 92. *pp.* 786–805, *June,* 1932.—The author writes equations of motion for a spectroscopic binary (a and e relatively small), disturbed by an encounter with a star whose path is assumed approximately rectilinear, and derives expressions for the variation of a and e. The average effect is evaluated assuming the direction and plane of encounter random for each distance of closest approach and velocity: first approximation effects disappear; second order effects in a are too small to be of importance; second order δe is higher than expected, but there are difficulties for small values of e. The paper is highly mathematical. T. L. M.

4180. Stellar Parallaxes Determined Photographically at the Cape Observatory (4th List). H. S. Jones. *Roy. Astron. Soc., M.N.* 92. *pp.* 730–737, *June,* 1932.—The present list contains stars No. 316 to No. 416, so numbered in continuation of the previous lists. [See Abstract 4143 (1931).] A. S. D. M.

4181. Effect of Preferential Motion on Mean Parallax from Peculiar Motions. A. Fletcher. *Roy. Astron. Soc., M.N.* 92. *pp.* 780–786, *June,* 1932.—Mean parallax $\bar{\pi}$ is connected with mean cross proper motion $\bar{\tau}$ and mean residual radial velocity $\overline{V}$ by $\bar{\pi} = 4{\cdot}74\ \bar{\tau}/\overline{V}$, if $\bar{\tau}$, $\overline{V}$ are random (no preferential motion). If there is preferential motion, $\bar{\tau}/\overline{V}$ is not affected so long as the stars are uniformly distributed over the sky; for galactic concentration $\overline{V}$ is exaggerated more than $\bar{\tau}$, therefore $\bar{\pi}$ is then generally too low. The correction of absolute magnitude is estimated, and its bearing on Cepheid luminosity discussed. T. L. M.

4182. Reduction of Spectroscopic Absolute Magnitudes to a Uniform System. P. J. van Rhijn. *Roy. Astron. Soc., M.N.* 92. *pp.* 744–771, *June,* 1932.—For the purpose of an investigation into the varying density of the stellar system, methods have been found for reducing all published spectroscopic absolute magnitudes of stars to one uniform system. Errors of two types must be considered, those of observation in measuring relative line intensities, and those due to the fact that other factors as well as absolute magnitude affect these intensities. When both types of error are taken together, it is found that they are distributed in accordance with a Gaussian curve, at least in the case of dwarf stars, and the same curve is assumed to hold for other classes also. The probable deviations of the curve are given for F to M, for A and for B stars respectively. M. A. E.

4183. Mean Parallaxes of Stars of First Six Magnitudes. F. K. Edmondson. *Astron. J. No.* 974. *pp.* 21–23, *June* 30, 1932.—The author describes the disadvantages in the three major methods of estimating mean parallaxes by (1) assumptions regarding distribution, density, absolute magnitude, etc.; (2) assumption of the relative motion of sun and group; and (3) the average of the radial velocities and of the proper motions. Regardless of the method used, the resulting mean parallaxes should represent the average of the true parallaxes of the group within reasonable limits of error. He presents a simpler method, from the computer's point of view. In any zone whose pole is the solar apex an observed radial velocity consists of the star's line-of-sight motion *plus* or *minus* a function of the sun's motion, and if a large number of the velocities in the zone are added without regard to sign, the sun's component becomes zero or very small; so he obtains $\Sigma | R_{obs} | = \Sigma | R_{star} | \pm \epsilon_1$, and similarly for the proper motion component $\Sigma | \mu_{obs} | = \Sigma | \mu_{star} | \pm \epsilon_2$. Whence he finds $p = 3{\cdot}016 \, \Sigma | \mu_{obs} | / \Sigma | R_{obs} |$, with which he computes the mean parallaxes of stars of the first 6 apparent magnitudes. He obtains very good numerical results from the *Bright Star Catalogue*, care being taken that the random data are evenly distributed in right ascension. A. S. D. M.

4184. Distribution of Light Intensity in Different Classes of Stellar Magnitude. K. F. Bottlinger. *Zeits. f. Astrophysik*, 4. *pp.* 370–395, *June* 28, 1932.—From statistics of stellar magnitudes, both apparent and absolute, the total intensity for each class of magnitude has been calculated, and the distribution in different regions of the heavens has been determined. At the galactic equator the greatest part of the light comes from stars of about the 13th apparent magnitude, and with increasing distance from the equator the total intensity diminishes (for each class and also for all together), but at the same time the maximum intensity is reached by brighter and brighter stars, up to 8·5 m. at the galactic pole. For absolute magnitudes, the maximum intensity in the solar neighbourhood is derived from stars of about $+1^{m.}$ visual ($+2^{m.}$ photographic). In special regions, such as star clouds and globular clusters, the distribution varies greatly. The probable dimensions of the stellar system are discussed with reference to the present data. M. A. E.

4185. Periods and Light Curves of 22 Variable Stars in Northern Border of Small Magellanic Cloud. Helen B. Sawyer. *Harvard Coll. Obs. Circ. No.* 374, [40 *pp.*], *May* 2, 1932.—A study was made of 23 variables nearest the globular cluster N.G.C. 362 to decide whether 3 Cepheids [see Abstract 3670 (1932)] are really members of the small cloud or whether the period luminosity relation does not hold for periods under 4 days. Of these 23, 20 proved to be classical Cepheids, 2 globular cluster Cepheids and of one the period was indeterminate. Since the classicals are in −43° galactic latitude, they without doubt belong to the Small Magellanic Cloud, to which also must therefore be assigned the 3 Cepheids apparently in N.G.C. 362. The two globular cluster Cepheids are probably isolated members of our own galaxy. A. S. D. M.

4186. Light Curves of Peculiar Variables, 1931. L. Campbell. *Harvard Coll. Obs., Circ. No.* 376. [8 *pp.*], *June* 25, 1932.—In continuation of previous work [see Abstract 4139 (1931)], a summary is presented of the observations made during 1931 of nine selected variable stars. The total number of observations amounts to over 4600. R Scuti passed through two somewhat deep minima. R Coronæ Borealis has remained practically at normal maximum brightness for more than seven years. M. A. E.

4187. Semi-Irregular Variable AF Cygni. D. J. K. O'Connell. *Harvard Coll. Obs., Bull.* 888. *pp.* 1–11, *July* 1, 1932.—Kanda and Vorontsov-Velyaminov have given formulæ, not very different but with a remarkably large periodic term; the author finds that both a 94-day and a 188-day (not merely double the 94 day) period are fundamentals connected with the activity of the star. There is some evidence that the photographic minimum precedes the visual and that the maximum velocity of approach occurs soon after maximum [see following Abstract]; its small proper motion shows it to be a giant; its closest affiliation is with certain RV Tauri stars. A. S. D. M.

4188. Correlations between Light and Radial Velocity Variations in Cepheid Variables. L. V. Robinson and D. Hoffleit. *Harvard Coll. Obs., Bull.* 888. *pp.* 12–16, *July* 1, 1932.—A study of 21 Cepheid variables with diagrams. The authors conclude: (1) maximum light and maximum velocity of approach do not always occur simultaneously, nor does maximum velocity of recession always occur simultaneously with minimum light; (2) within the limits of error, maximum velocity of approach never precedes maximum light [see preceding Abstract], and maximum velocity of recession never precedes minimum light; (3) the lag of maximum velocity of approach is not a function of period, but is apparently correlated with peculiarity of light and spectrum. Within the limits of error maximum light does occur at zero velocity for RR Lyræ and RU Camelopardalis, but for other cases sufficient information as to temperature is wanting. A. S. D. M.

4189. Infra-Red Sensitive Photoelectric Cells in Stellar Photometry. J. S. Hall. *Nat. Acad. Sci., Proc.*, 18. *pp.* 365–367, *May*, 1932.—Apparatus: Cæsium oxide on silver photo-cell cooled by liquid air or solid carbon dioxide; the Loomis cœlostat; Lindemann electrometer. The cooling reduces the dark current very greatly. Measurements down to $6^{\mathrm{m.}}$, red stars have considerable accuracy and relative magnitudes are consistent from one night to another. The current is very nearly proportional to incident light from $3^{\mathrm{m.}}$ to $6\cdot5^{\mathrm{m.}}$ T. L. M.

4190. Detection of the Gegenschein with a Photoelectric Photometer. C. T. Elvey. *Astrophys. J.* 75. *pp.* 424–426, *June*, 1932.—Observations of the brightness of the sky with the photoelectric photometer of the Yerkes Observatory across the region of the gegenschein show its presence, and also show the possibility of a detailed study of it. AUTHOR.

4191. Evidence for Space Reddening from Bright B Stars. Emma T. R. Williams. *Astrophys. J.* 75. *pp.* 386–393, *June*, 1932.—A comparison of the mean colours of Struve's giants, intermediates and dwarfs shows that the giants of any class are much reddened and the intermediates are somewhat reddened. The discussion shows that this is space reddening, and that the effect of absolute magnitude is negligible. Struve's classification is also confirmed by secular parallaxes. AUTHOR.

4192. Space Survey in the Carina Region. C. Jane Anger. *Harvard Coll. Obs., Circ.* 373. [10 *pp.*], *April* 11, 1932.—The interesting region near η Carinæ is rich in *c*-stars, B and O stars, and stars with peculiar spectra, and from a discussion of the Cepheids McLaughlin concluded that the star-clouds here are of great depth, the furthest-known variables being at a distance of about 15,000 parsecs. Spectroscopic parallaxes have now been determined for 239 stars in this region, by means of the strength of their hydrogen lines. A strong concentration of faint and moderately luminous stars is found at 250 parsecs, some evidence for another at 650 and a probable concentration of very luminous stars at about 1100–1200 parsecs. The distribution of supergiants is, however, fairly uniform. The methods of the survey are described, and a catalogue is given of the stars observed, with their line intensities, spectroscopic absolute magnitudes and distances in parsecs. M. A. E.

4193. Variable Lines of Helium and Magnesium in the Spectrum of 13 μ Sagittarii. W. W. Morgan. *Astrophys. J.* 75. *pp.* 407–412, *June*, 1932.—The absorption lines HeI 4471 and MgII 4481 have been found to vary in intensity in the spectrum of the long-period spectroscopic binary μ Sagittarii. The variation is in the period of orbital revolution of the binary system, λ4471 rising to a sharp maximum at the time of periastron, while λ4481 decreases to a minimum at the same time. It is probable that the helium line, λ4026, varies in phase with λ4471, while four other lines, due to the same element, do not show any measurable variation. The silicon and hydrogen lines may be variable, but the material is not complete enough or sufficiently homogeneous to permit certainty. The variability of the absorption lines is probably due, in some manner, to the close approach of the two stars at periastron, as the eccentricity of the system is high and the principal star is a supergiant. AUTHOR.

4194. Spectrum of B.D. + 11°4673 During the Years 1929–1931. P. W. Merrill. *Mt. Wilson Observat. Contrib. No.* 450. *Astrophys. J.* 75. *pp.* 413–422, *June*, 1932.—Twenty-two single-prism spectrograms taken during 1929–1931 serve as a basis for a further study of this complex Be spectrum. No radical changes in the character of the spectrum occurred during this interval, and the 800-day fluctuations in the intensities and displacements of the lines were repeated approximately as before [see Abstract 3529 (1929)]. Detailed data are given concerning the bright and dark lines of H, He, FeII, Al III, NII and SiIII. Anomalous differences in phase previously found for various elements are confirmed. Certain small deviations from the earlier behaviour are noted, including a possible lengthening of the period. The dark lines have continued to move towards shorter wave-lengths. The question is raised whether the phenomena observed in this spectrum have any relationship to the small discrepancies noted in Cepheid variables between results from various lines. AUTHOR.

4195. Spectrum of Nova Pictoris (1925) 1931–1932. H. S. Jones. *Roy. Astron. Soc., M.N.* 92. *pp.* 728–730, *June*, 1932.—The 1932 spectrum shows close correspondence with 1931 [see Abstract 3388 (1931)], confirming several faint or suspected lines then measured, and a table of these is given. The strong lines at λλ5723, 6087, retain their same relative intensities, they are of unknown origin. Some weak emission lines are probably like those in Wolf-Rayet stars. A. S. D. M.

4196. Spectrum of 37 θ Aurigæ. W. W. Morgan. *Astrophys. J.* 75. *pp.* 423–424, *June*, 1932.—A number of lines in the spectrum of 37 θ Aurigæ have been found to vary in intensity. Most of the variable lines are due to CrII. With respect to the variation of the chromium lines the star is similar to B.D.–18°3789. AUTHOR.

4197. Photoelectric Study of ε Aurigæ. C. M. Huffer. *Astrophys. J.* 76. *pp.* 1–8, July, 1932.—At Washington, photoelectric observations by Stebbins and the author were begun on January 20, 1928. In 1912 Ludendorff had published light-elements and classified the star as an Algol variable with a period of 9905 days, determining the period by the beginning and ending of the " eclipse " and by the ending of " totality." The Washington observations show that these points are marked by secondary fluctuations in which it is impossible to find continuous regularity (four fluctuations are apparently evenly spaced at 336-day intervals, but this does not continue). The author therefore uses all points on the descending and ascending branches of the curves, and determines the middle dates; those with Ludendorff's dates for the two preceding minima yield elements, $t_1 = \text{J.D. } 2425725 + 9883^{d} \cdot E = 1929 \cdot 308 + 27^{y} \cdot 059E$. At the recent minimum, loss of light was $0^{m} \cdot 81$; duration of decrease and increase, each 1·7 days; of minimum 360 days: or 754 days for the entire eclipse. Comparing this transit with that of Saturn; the latter to a distant star takes about 1·7 days to cross the sun, but ϵ Aurigæ, with a slightly shorter total period, shows a transit of at least 197 days. If the star eclipsed at minimum is a sphere, then if the comparison is a single body or a meteor swarm the upper limit of density of the primary is $5 \cdot 6 \times 10^{-7}$ that of the sun. If both are spheres (which is very doubtful), the density is $2 \cdot 1 \times 10^{-8}$ irrespective of the distribution of mass. A. S. D.M.

4198. Stellar Hydrogen Line Contours and their Variation with Temperature and Surface Gravity. E. G. Williams. *Solar Phys. Obs. Cambridge, Ann.* 2. *pp.* 25–47, 1932.—An investigation into the variations in H absorption lines with effective temperature (Te) for stars of constant g, and with g for stars of constant Te. Visual binaries, and a modification ($L = \mu^{3 \cdot 8}$) of Jeans' mass-luminosity law, and the Greenwich temperature scale are used. In the photometric considerations, special attention is paid to plate standardisation, to sources of error from instrumental limitations, to the Eberhard effect, and to the tracing of the continuous background. H absorption is a maximum between A_5 and A_0, when the absolute magnitude effect is such that the stars with gravity forty times greater have four times the H absorption (which is contrary to theory, and the Stark effect does not account for this). The absolute magnitude effect reverses at about 7500° in type F. There is statistical correlation between line depth and Te; the mean central density for all stars is 36 %, which again disagrees with theory, and is not accounted for by Stark or by rotational effect. Giants have deep lines in late-type stars; in hot stars rotational effect fills the line centre by 12 % per 100 km/sec. Early-type stars have exponential contours for H lines. A. S. D. M.

4199. Determination of Spectral Types, Magnitudes and Star Densities in Galactic Latitude − 25°. E. Stenquist. *Arkiv. f. Mat. Astron. och. Fysik, Stockholm,* 23*A*. 5. [58 *pp.*], 1932. *In English.*—The author continues for south galactic latitude 25° and longitude about 100°, the work of Lindblad, Peterssen and Schalén on the space distribution of stars of spectral types A and gG0–K2 in the same longitude but northern galactic latitudes. Nine spectrum plates are used and two more for the international scale zero-point. The classification is the Harvard scheme as modified by Lindblad. There is only one B star as the galactic latitude is high; for A and F stars the luminosity classification is by the strength of H lines; for late-type stars by the colour equivalent of the band G (log E_g), and the CN absorption at λ4216 (log E_n); the latter is algebraically greater for giants than for dwarfs of the same type. The space densities of A and gG0–K2 stars decrease with distance from the galactic plane, and is more pronounced for A than for late-type giants; for distances > 135 parsecs the space density of late-type giants is greater. The density law for A stars is $D(r) = D_0 \cdot \rho^{-r^2/2\rho^2}$. Both early and late types place the sun in north galactic latitude. There are ten diagrams and a catalogue of 1139 stars (showing the B.D. number, the Upsala apparent, and absolute photographic magnitudes, the Upsala and Draper Catalogue spectral types, and the distance in parsecs of A stars as given by the formula $\log r = 1/5(m - M) + 1$. A. S. D. M.

4200. Centre of System of Stars of Different Spectral Types. S. Hirayama. *Imp. Acad. Tokyo, Proc.* 8. *pp.* 228–230, *June*, 1932.—Coordinates of the centre of the stellar system have been computed for different magnitudes and different spectral types of stars, the data being taken from Charlier's *Statistical Notes on the Draper Catalogue*. The centres deduced from B stars of different magnitudes agree very nearly with those deduced from all the types taken together, which confirms an early result of Charlier that the B stars are distributed throughout the entire stellar system. The divergence both in latitude and longitude of the centres found for A stars suggests that they congregate in small local clusters distributed in different regions of space, and the same applies to the nearest F and G stars, but for K the discordance is not so great. Our system seems to be a rather heterogeneous aggregation of stars of different types. M. A. E.

4201. Stellar Velocities and Temperature of the Galaxy. H. Mineur. *Comptes Rendus*, 195. *pp.* 30–32, *July* 4, 1932.—The distribution of stellar velocities, when the sun's motion is subtracted and the galactic rotation taken into account, should enable us to determine whether or not the galaxy is in a state of isothermal equilibrium, as is generally assumed, for its temperature must be in proportion to the velocities of the stars, as the temperature of a gas is proportional to the kinetic energy of its molecules. All radial velocities of stars so far published have been used in this research, and the result, unless it is due to errors inherent in every calculation based on experimental data, shows that with increasing distance from the galactic centre either stellar velocities and the temperature of the galaxy increase, or the ellipsoids of stellar velocities increase in length while the minor axis remains constant. A study of spatial velocities would enable us to decide which of these interpretations is correct. M. A. E.

4202. Milne's Theory of Stellar Structure. H. N. Russell. *Roy. Astron. Soc., M.N.* 92. *pp.* 831–836, *June*, 1932.—Considers the physical implications of Milne's conjecture that one or both of the characteristic lengths appearing in his analysis is of the order of magnitude of the radius of the " star " involved. Shows that in fact appreciable differences between the two quantities must occur in some cases. For stars of small mass the equations may also be integrated, and they give Jeans' result that a polytrope of index 3½ will be a good approximation throughout most of the star; Milne's analysis is thus not inconsistent with the existence of purely gaseous stars of small mass and radius. For larger masses an approximation due to Jeans indicates that there must in fact be a non-gaseous core. The gaseous configurations of Milne's theory are shown to be translucent. R. d'E. A.

4203. Dark Nebula Near ξ Ophiuchi. R. Müller. *Zeits. f. Astrophysik*, 4. *pp.* 365–369, *June* 28, 1932.—Star counts in and around this nebula of very irregular form indicate that, unlike some extensive nebulæ which strongly absorb starlight, it has an absorbing power equivalent to less than one magnitude, and is comparatively shallow and near, its distance on the side furthest from us being only about 200 parsecs. [See Abstract 1920 (1932).] M. A. E.

LIGHT.

4204. Coloured Forms of Diphenylamine Derivatives. N. M. Cullinane, Olga E. Embrey and D. R. Davies. *J. Phys. Chem.* 36. *pp.* 1434–1448, *May,* 1932.—Reference is made particularly to the work of Hantzsch. The two forms of 2:4:6-trinitro-4′-methyldiphenylamine and 2:4-dinitro-5-methyl-2′-methoxydiphenylamine respectively are different in colour, crystalline structure and density. Each form, in solutions of equal strength in pyridine, differs in colour and refractive index. It is stated therefore that the two modifications for each of these substances are chemical isomerides. As no distinctions are observed for the two modifications of 2:4-dinitro-5-methyl-4′-ethoxydiphenylamine except in the solid state they are considered to be dimorphic forms. The two forms of 2:4-dinitro-2′-methoxydiphenylamine, and of 2:4:6-trinitrodiphenylamine are assumed to be identical save in colour, as their densities, solubilities, colours and refractive indices of solutions of equal concentration are in substantial agreement. J. K.

4205. Ultra-Violet Transmission of Thin-Blown Glass Windows. H. Klumb and T. Haase. *Zeits. f. Physik,* 76. 5–6. *pp.* 322–327, *June* 7, 1932.—Thin-blown windows of glass or quartz of thickness of the order 10 μ can, when suitably shaped, withstand pressure differences of an atmosphere or more, and have been used in many recent investigations in the ultra-violet and long-wave X-rays for the sake of their high transmission. Specimens of these thin films of glass of several commercially available varieties were examined. The qualitative absorption in the visible and ultra-violet was determined photographically, and quantitative measurements were made at wave-lengths 2537, 2900, and 3100 Å., with the aid of a double monochromator and a photoelectric cell. Transmissions as high as 80 % were obtained in some cases for these wave-lengths. The mechanical properties and gas tightness of the films are also discussed.
W. S. S.

4206. Shift of the Transmission Band of Silver by Cold Working. H. Margenau. *Phys. Rev.* 40. *pp.* 800–801, *June* 1, 1932.—It is pointed out that the shift of the reflection minimum of silver, occurring as a consequence of cold working the silver surface, can be understood on the basis of Kronig's theory of metallic dispersion as a result of the change in the lattice constant. Correlation with known values of the density changes leads to satisfactory agreement. [See also Abstract 2843 (1932).]
AUTHOR.

4207. Plane Waves of Light. Part III. T. C. Fry. *J.O.S.A.* 22, *pp.* 307–332, *June,* 1932.—The author works out in detail the mathematical theory of the absorption of light by metals, (*a*) when light is incident from a dielectric on to a semi-infinite conductor, (*b*) when the conductor is covered with a layer of another conductor. The theory is based on Maxwell's electromagnetic equations, where, in the final results, the empirically determined values of the optical constants of the metal or metals are to be inserted. The ideas of "bulk," "intrinsic" and "lamellar" absorbing powers are developed. The investigation is designed to throw light on the relation between the photoelectric emission of metals, including thin

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films, and their optical absorption properties. [For Part II see Abstract 1224 (1928).] W. S. S.

4208. Penetration of Daylight into the Sea. E. O. Hulburt. *J.O.S.A.* 22. *pp.* 408–417, *July*, 1932.—During descents into the sea to depths of over 1400 ft. Beebe observed that the colour of the water illuminated by the sun was a pure blue and measured the candlepower of the illumination at various depths down to 800 ft. At 800 ft. the spectrum was a narrow band at about wave-length 520 mμ. Using the light absorption coefficients of sea water as measured in the laboratory and the Raman–Einstein–Smoluchowski theory of the scattering of light in liquids, it is found that the spectrum of the daylight at 800 ft. in the sea has a maximum brightness at about 500 mμ; this agrees well enough with the observation. The calculated candlepowers of the undersea daylight illumination were much greater than the observed values. The assumption that the absorption in the sea below 200 ft. was the same as the laboratory measured absorption and in the surface layers down to 200 feet was about five times the laboratory value led to good agreement between the observed and calculated candlepowers at all depths. The surface layer absorption would be accounted for if 25 millionths of the volume of the surface water were occupied by opaque material. AUTHOR.

4209. Trichromatic Colorimeter. J. Zernike. *J.O.S.A.* 22. *pp.* 418–421, *July*, 1932.—Describes a trichromatic mixture colorimeter which employs as its primaries the 435μ and 546μ lines from a mercury-vapour lamp, and the 627 and 638μ lines from a neon lamp. These lines are isolated by means of appropriate filters. The intensities of the primaries are varied partly by the use of adjustable diaphragms and partly by moving the lamps towards or away from diffusing glass plates, which serve as the actual sources. The mixed light is then compared in the usual way with the illuminated sample under examination. Methods of converting from these primaries to the usual trichromatic primaries are being developed. J. W. T. W.

4210. Trichromatic Colorimeter. R. A. Houstoun. *Optical Soc., Trans.* 33. 5. *pp.* 199–206; *Disc.*, 206–208, 1931–1932.—The design and construction of the instrument are described. It is on a new principle, the intensity of the comparison field being altered by an iris diaphragm, and the colour by moving a magenta-yellow and a blue-magenta filter relatively to one another. Results are given which have been obtained with the instrument. AUTHOR.

4211. Elementary Colorimetric Theory. T. Smith. *Optical Soc., Trans.* 33. 5. *pp.* 214–227, 1931–1932.—The meanings to be assigned to the symbols =, +, and − in a colour equation, and the extent to which elementary algebraic manipulation is permissible, are considered. The nature of the colour triangle and of the variables used in colorimetry are discussed. AUTHOR.

4212. Calibration Coefficients of Colorimeters. T. Smith. *Optical Soc., Trans.* 33. 5. *pp.* 228–229, 1931–1932.—Variations in the transmissions of the filters for light of any given wave-length alter the calibration constants of a colorimeter, and expressions are developed for these changes in order to ascertain what accuracy is necessary in spectrophotometric tests to yield ample accuracy in the calibration. The formula obtained is suitable for use for a considerable length of the spectrum, and involves only instrumental quantities utilised in the computation of the normal calibration coefficients. **Author.**

4213. Correction of Luminosities of Colorimetric Units. T. Smith.—*Optical Soc., Trans.* 33. 5. *pp.* 231–233, 1931–1932.—The trial-and-error method of correcting observed luminosities so as to be consistent with the standard visibility function may be replaced by the direct method described. **Author.**

4214. Visibility of Objects Illuminated by a Projector. Part I. Y. Rocard. *Rev. d'Optique,* 11. *pp.* 193–211, *May, and pp.* 257–278, *June-July,* 1932.—The author discusses the factors determining the visibility of an object in the beam of a searchlight—brightness contrast between object and background, angular dimensions of the object, colour of the light, position of the observer, etc. The outstanding factor is the brightness contrast, which is determined by the reflection factor of the object, the absorptive and scattering power of the atmosphere, and the angular distribution of intensity in the searchlight beam. For the latter a given form is assumed, and the properties of the atmosphere are expressed by one variable parameter (the total absorption); for the change with angle of the scattered intensity from a small element of the atmosphere, a fixed law is adopted. The calculations of this part are mainly concerned with determining the background brightness due to once scattered and twice scattered light, for different distances of the observer from the projector, and for different directions of view. In addition, the illumination of the object by scattered light is also calculated. The luminous beam tends to act as a glare source reducing the visibility of the object, and the effect is equivalent to an increase in the general brightness level. A calculation of the equivalent background brightness due to this cause is outlined. W. S. S.

4215. Convergence of the Eyes and Stereoscopic Effect. Y. le Grand. *Comptes Rendus,* 195. *pp.* 176–178, *July* 11, 1932. *Rev. d'Optique,* 11. *pp.* 313–323, *Aug.,* 1932.—Describes a series of experiments on the amount of convergence which will just give a sense of relief. A difference of depth may be perceived either by the ordinary process of combination of images to give stereoscopic relief or by the change of convergence of the eyes as one point is looked at after another. The former mechanism governs the appearance of relief in an object viewed by an instantaneous flash, while the latter mechanism only can come into play when one point is viewed after another, the two points under consideration being shown alternately and never simultaneously. Under these conditions a difference of depth can only be perceived if the eyes retain a given degree of convergence throughout the interval and appraise the change of convergence necessary to focus the second point on its appearance. The least difference of convergence thus appreciable was found by the author to be $18''$ of arc, and this was practically constant for all distances of the object viewed, at any rate from 1 m. to ∞. J. W. T. W.

4216. Retinal Chromatic Fields as a Function of Wave-Length. C. A. Rinde. *J.O.S.A.* 22. *pp.* 333–356, *June,* 1932.—The experimental measurements consisted in moving a bright monochromatic patch from the periphery of the observer's visual field along the horizontal meridian, and noting the angular positions at which different colour sensations were first experienced by the observer. The patch was a circle of diameter subtending 49′ at the eye; it was illuminated with an arc and diffraction grating, and was seen against a dimly lighted neutral grey background. One object of the work was to see if the pairs of colours, red-green and blue-yellow were characterised by identical chromatic field size of the components. Field-size measurements at 638, 528, 593 and 464 mμ failed to show any pairing up as suggested, but other variable factors may have masked the effect. The second part of the investigation gives the chromatic field sizes for wave-lengths ranging through the whole spectrum. In most cases there are two limits, one when a colour is first experienced, and another when this colour undergoes a definite change of hue. An extended discussion of the significance of the results and comparison with the work of other investigators are included. W. S. S.

4217. Trichromatic Functions of the Average Eye. W. F. Hamilton and E. Freeman. *J.O.S.A.* 22. *pp.* 369–387, *June,* 1932.—Using three spectral primaries (670, 517 and 480 mμ), the authors determined for sixty-eight subjects the relative amounts of the primaries required to match white. The results show that the sensitivity of this large group of observers, to a given primary, follows the normal distribution law, and not a bimodal segregation as König supposed. A second part of the work deals with the loss of saturation in mixtures which match spectral colours from 577 to 517 mμ. Effects of this kind previously reported are ascribed in part to the use of the dark-adapted retina and an " impure " green primary. W. S. S.

4218. Relative Sensitivity of Eye and Photographic Plate for Observation of Faint Spectrum Lines. M. Minnaert. *Zeits. f. Astrophysik,* 4. *pp.* 358–364, *June* 28, 1932.—In many cases where time of observation is limited (spectrum of corona, aurora, etc.), the author shows that the eye may note details (such as faint lines) which would require excessive photographic exposure. The problem therefore arises as to how much exposure is necessary to photograph what can just be observed visually (limiting exposure for superiority of photograph). Numerous factors are discussed: type of plate; intensity of spectrum as a whole; absorption and emission lines; great variation in sensitivity of both eye and plate in various regions. The eye is most advantageous for strong lines, and in the green region; the difference between strong and weak lines increases towards the violet. It is concluded that visual observations of the corona are desirable; other special applications of visual work are proposed. T. L. M.

4219. Intensity, Area, and Distance of Visual Stimulus. E. Freeman. *J.O.S.A.* 22. *pp.* 402–407, *July,* 1932.—The threshold intensity for the dark-adapted eye was determined for a test object in the shape of a narrow strip of light seen against a dark background. The variation of threshold brightness with strip width, and hence with stimulus area, was determined. A strip ten times as long, placed ten times the distance away, was then used, and the measurements repeated. The results are represented by an empirical formula. The author concludes from this and other work that the threshold intensity and visual acuity for objects of the same *angular* dimensions as seen from the eye, are not independent of the distance between object and eye. W. S. S.

4220. Optical Constants of Copper. H. Lowery and R. L. Moore. *Phil. Mag.* 13. *pp.* 938–952, *June,* 1932.—An attempt is made to discover some relation between the state of strain of a copper surface due to varying degrees of polish and the optical constants, using a polarimeter method, also to assess the rate at which atmospheric deterioration takes place. It seems evident from the results, using $\lambda 5770$, that a heavy polish increases the refractive index, and decreases the absorption and reflection coefficients. This agrees with Margenau's results for silver, but there seems to be an apparent deviation from those of Drude and Tate. H. M. B.

4221. Measurement of Reflecting Power. M. Duffieux. *Rev. d'Optique*, 11. *pp.* 212–214, *May*, 1932.—Fabry and Buisson's photometer for determining the reflecting power of transparent metallic films on glass, employs polarised light. For the modified method here described, ordinary light can be used. Two illuminated apertures situated side by side in an opaque screen, lie in the focal plane of a corrected lens, and their images at infinity are viewed through two slightly inclined glass plates, each having a specimen of the given metallic film " silvered " on one surface. Each aperture gives rise, by multiple reflections between the two silvered surfaces, to a series of images whose brightnesses decrease geometrically with the ratio r^2, where r is the average reflecting power of the two surfaces. By bringing the nth image of one hole into juxtaposition with the mth image of the other, and matching the brightnesses by the aid of a variable absorbing wedge in one beam, a determination of the reflecting power is obtained. By suitable choice of m and n the precision obtained is very high, and for high reflection factors amounts to 0·25 %. W. S. S.

4222. Reflection Factors of Crystals. A. Cissarz. *Zeits. f. Krist.* 82. *pp.* 438–450, *June*, 1932.—Describes the results of measurements of the reflection factors of crystals likely to be suitable as standards of reflectivity. It is concluded that the most convenient crystals are, for measurements in air, freshly formed surfaces of yellow zinc blende from Santander and, for measurements in air or in oil, galena from any source whatever. The figures obtained for galena from thirty different sources are tabulated, and the differences found are very small indeed.

J. W. T. W.

4223. Measurement of Reflection Coefficients for Oblique Incidence. H. E. Beckett. *Phys. Soc., Proc.* 44. *pp.* 439–444, *July* 1, 1932.—A method is described whereby the effect of obliquity of incidence upon the reflection coefficients of certain materials can be examined. The material is spread upon the metal receiver of a thermopile which, when exposed to radiation, yields an e.m.f. proportional to the absorption coefficient of the surface. Results obtained with black and white paints and with polished copper are discussed. [See Abstract 3029 (1931).]

AUTHOR.

4224. Light Transmitted in "Total Reflection." A. de Gramont. *Rev. d'Optique*, 11. *pp.* 156–158, *April*, 1932.—In continuation of previous work [see Abstract 1859 (1931)], the light transmitted by a reflecting surface at " total reflection " is studied for a number of particular cases. No transmission was found for a liquid–air surface with alcohol or paraffin oil, but water gave a positive result, probably due to dust. The immersion of a totally-reflecting prism in water diminishes the amount of light transmitted by its reflecting surface, but semi-silvering (kathodic) has little effect. C. B. A.

4225. Infra-Red Dispersion of Carbon Dioxide. H. M. Smallwood. *Phys. Rev.* 41. *pp.* 164–166, *July* 15, 1932.—The term in the dispersion equation of CO_2 corresponding to the bending vibration ($\lambda = 14 \cdot 91\,\mu$) has been calculated from the assumption that this dispersion is due to interaction of the electric vector of the light wave and the permanent dipole moments associated with the carbon-oxygen valence bonds. The calculation indicates a magnitude of $1 \cdot 17 \times 10^{-18}$ e.s.u. for these dipoles, which is shown to be in agreement with the value to be expected from the measured moment of acetone. AUTHOR.

4226. Determination of Refractive Indices. A. Biot. *Ann. Soc. Sci. de Bruxelles,* 52. *pp.* 58–60, *June* 8, 1932.—The method proposed is applicable to lenses of known form and to prisms of known angle. The index required, N is found as the sum of that for the immersion liquid n, and a small quantity Δn found by the grazing incidence method. The sample under test, a quartz prism, is placed between the plates of a Fabry-Pérot standard and immersed in a mixture of CS_2 and CCl_4. If e is the distance between two points separated by α fringes, then $\Delta n = \alpha\lambda/2e$. The goniometer used for n gives a precision of 2″. The value of N found was $1 \cdot 54615$ at 20° C. for quartz with a precision of 1×10^{-5}. This agrees perfectly with the value calculated from the Hartmann formula. R. S. R.

4227. Molecular Structure and Refractive Dispersion of Prussic Acid and its Homologues. T. M. Lowry and S. T. Henderson. *Roy. Soc., Proc.* 136. *pp.* 471–487, *June* 1, 1932.—Improvements in the methods of measuring refractive indices with a refractometer are described whereby the mean deviation has been reduced to about five units in the fifth decimal place. Measurements have been made of the refractive indices of prussic acid and of the homologous methyl and ethyl cyanides and isocyanides for twenty-six wave-lengths in the visible spectrum and over a range of wave-lengths extending to 2473 Å. in the ultra-violet. These refractions can be expressed by equations of the Ketteler–Helmholtz type, the characteristic frequency being at 978 Å. for prussic acid, 994 Å. for methyl and ethyl cyanides, and 1085 and 1067 Å. for methyl and ethyl isocyanides. By comparing the molecular refractions of prussic acid with those of the cyanides and isocyanides it has been shown that the liquid acid consists almost exclusively of HCN. AUTHORS.

4228. Variation with Concentration of Equivalent Refraction of Dissolved Strong Electrolytes. G. Pesce. *Zeits. f. phys. Chem.* 160. *Abt.A.* 3–4. *pp.* 295–300, *June,* 1932.—The apparent refractions of $CaCl_2$, $SrCl_2$, and Na_2CO_3 in aqueous solution vary linearly with concentration from about normal to saturation, those of $CaCl_2$ and $SrCl_2$ decreasing at the same rate, that of Na_2CO_3 increasing. These rates are compared with that of $BaCl_2$ [see Abstract 85 (1932)], and their relative values shown to correspond with the molecular lowering of freezing point, and so to indicate degree of ionic association. The ionic refractions for D_3 of the dissolved ions, Na^+ being $0 \cdot 200$ [see Abstract 2647 (1931)], are $1/2Ca^{++}$, $0 \cdot 35_0$; $1/2Sr^{++}$, $0 \cdot 94_0$; $1/2CO_3^{--}$, $6 \cdot 07_6$. C. A. S.

4229. Optical Dispersion. S. A. Korff and G. Breit. *Rev. Modern Physics,* 4. *pp.* 471–503, *July,* 1932.—A review of the subject of optical dispersion which, in addition to an historical survey and an exposition of the classical theory, together with the modifications due to the quantum theory, includes a survey of the various methods which have been employed and tables of the more important results obtained to date. [See following Abstract.] A. H.

4230. Quantum Theory of Dispersion. G. Breit. *Rev. Modern Physics*, 4. *pp.* 504–576, *July*, 1932.—A detailed exposition of the quantum theory of dispersion and its development [see preceding Abstract]. A. H.

4231. Constants of Aliphatic Alcohols. C. H. Kao and S. Y Ma. *Tsing Hua Univ., Sci. Reports*, 1. *pp.* 181–183, *July*, 1932. *In English*.—The densities and refractive indices at 15°, 20° and 25° C. of the ethyl esters of the normal fatty acids, C_5–C_{10}, and the higher aliphatic alcohols, C_5–C_{10}, have been accurately determined. AUTHORS.

4232. Double Refraction of Industrial Glasses. J. Escher-Desrivières. *Rev. d'Optique*, 11. *pp.* 215–221, *May*, 1932.—The author describes the methods in current use for determining the double refraction produced by imperfect annealing in commercial glassware. In most cases the body under examination has to be immersed in a liquid of equal refractive index. The author proposes a method in which such immersion can be avoided. The object is examined by means of a mirror form of strain detector arranged to produce the sensitive tint, and the double refraction existing at any point in the body is compensated by means of a compressed glass block compensator. The construction of this latter piece of apparatus is described and the method is shown to be both rapid and precise. J. W. T. W.

4233. Lorentz Double Refraction in the Regular System. E. U. Condon and F. Seitz. *J.O.S.A.* 22. *pp.* 393–401, *July*, 1932.—In classical crystal optics the inhomogeneities of the electric field due to the finite wave-length are commonly neglected, *i.e.*, the polarisation is assumed to depend only on the actual values of the electric field and not on the field gradients. The present paper works out the theory, taking into account the effects of the field gradients of the first and second order ($\partial E_l/\partial x_j$, $\partial^2 E_l/\partial x_j \,.\, \partial x_k$). These higher approximations give double refraction even for crystals of the regular system which are optically isotropic in the earlier theory. A three-dimensional tensor and matrix system is employed in the analysis, which is of considerable value in problems of crystal optics. The optical properties of the regular (cubic) system of crystals are discussed particularly. W. S. S.

4234. Rotatory Dispersion of Camphor and Camphor Derivatives. T. S. Patterson, Edith F. M. Dunn, C. Buchanan and J. D. Loudon. *Chem. Soc., J. pp.* 1715–1725, *June*, 1932.—The rotation of camphor alone [see Abstract 2373 (1932)] and in various organic solvents has been examined and found to vary from a maximum of $[\alpha]_{5461}^{19°} = +76°$ in ethylene bromide ($t = 15°$, $p = 4{\cdot}5$) to a minimum of 23·07° in phenol ($p = 25{\cdot}8$). It has also been examined in concentrated and diluted sulphuric acid, in the former of which the rotation is depressed to $-75{\cdot}6°$ ($t = 0°$; $p = 2{\cdot}83$). Isonitrosocamphor, camphoroxime and oxymethylenecamphor were also examined. In general the data lie with satisfactory regularity upon the lines of a characteristic diagram, the greatest discrepancy occurring in the case of isonitrosocamphor. The rational zero for camphor v/g is $-16{\cdot}5°$. H. H. Ho.

4235. Rotatory Dispersion of Camphor Derivatives. T. S. Patterson and J. D. Loudon. *Chem. Soc. J., pp.* 1725–1744, *June*, 1932. —Camphor-10-sulphonic acid is found to exhibit negative rotation in concentrated sulphuric acid, whilst in the aqueous acid the visibly anomalous region of rotation for the compound has been realised. The rotations of the methyl and ethyl esters of the α-chloro- and α-bromo-derivatives, of the corresponding amides, and of α-chloro- and α-bromo-camphor have been examined under different conditions of solvent and temperature, and the data discussed with reference to the characteristic diagram. The rational zero *v/g* for camphor-10-sulphonic acid is −22·2°, *i.e.*, not far removed from that of camphor, but the data for the esters do not appear to lie on the same characteristic diagram, the rational zero *v/g* for the α-chloro- and α-bromo-derivatives being approximately +11° and +24·5° respectively. Camphor and its 10-sulphonic acid have probably a laevo- and the α-halogenated camphor derivatives a dextro-rotatory configuration. H. H. Ho.

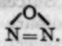
4236. Interpretation of a Magneto-Optical Effect. M. Cau. *Comptes Rendus,* 194. *pp.* 2043–2045, *June* 6, *and pp.* 2204–2206, *June* 20, 1932.—Pogány's conclusions [see also Abstract 56 (1918)], that non-ferromagnetic metals placed in contact with a thin layer of magnetised iron may exhibit a specific Faraday effect attributable to the action of a very intense field due to the iron and ascribed to a molecular field, are now explained entirely by superficial magneto-optical actions and multiple reflections in the metallic layers [see also Abstract 3700 (1932)]. The theoretical values of the effects have been calculated for platinum in certain particular cases and compared with experimental data connecting the general course of the variations with the thickness of the metallic layers. The second paper records data for variations of thickness of the platinum. H. H. Ho.

4237. Influence of Temperature on the Natural and Magnetic Rotation of d- and l-α- and l-β-Pinene. C. Salceanu. *Comptes Rendus,* 194. *pp.* 2136–2138, *June* 13, 1932.—The ordinary and magnetic rotations of these liquids have been determined at several temperatures up to 141·5° for λλ5780, 5460, and 4360. As regards natural dispersion β-pinene behaves differently from the α-pinenes, and from its own benzene solution, indicating either a different polymerisation or peculiar absorption. [See Abstracts 1516 (1931) and 2808 (1932).] C. A. S.

4238. Anomalous Dispersion of Magnetic Double Refraction. R. Lucas and M. Schwob. *Comptes Rendus,* 194. *pp.* 2296–2299, *June* 27, 1932.—The authors have already come to the conclusion from work on the optical properties of certain tartaric and camphor derivatives that these optically active bodies can exist either in solution or in a homogeneous liquid phase in monomolecular forms in equilibrium [see Abstract 2360 (1932)]. The factors determining the equilibrium are the nature of the solvent, the concentration, the temperature and the pressure. While most active bodies obey strictly Havelock's law for dispersion, these anomalous ones do not. Results obtained with a field of 40,000 gauss for the magnetic double refraction of racemic camphor and camphor itself are given and show their anomalous behaviour and the effect of the nature and concentration of the solvent. It is considered impossible to explain the results other than by the assumption of the existence of two kinds of molecules having double refraction of opposite signs. J. E.

4239. Action of Mechanical and Electrical Fields of Force on the Double Refraction of Quartz. N. Günther. *Ann. d. Physik,* 13. 7. *pp.* 783–801, *June* 2, 1932.—The paper is mainly theoretical, though the conclusions are subjected to experimental verification. The object of the investigation is to show the interdependence of the elastic and optical constants and the constant of the double refraction due to deformation. It thus involves consideration of the Kerr effect and of the piezoelectric effect. J. H. A.

4240. Secondary Phenomena in the Kerr Effect in H.F. Fields. H. Hoyer and L. Pungs. *Phys. Zeits.* 33. *pp.* 531–534, *July* 15, 1932.—The "fringe" and birefringence effects observed by Sirkar and Cotton-Mouton respectively in Kerr cells, particularly at high frequencies, are attributed to heating produced by dielectric losses, which give rise to a regular convection current in the Kerr field and to deformation birefringence in the end plates of the cell. C. B. A.

4241. Kerr Effect, Optical Anisotropy and Molecular Structure. H. A. Stuart and H. Volkmann. *Zeits. f. phys. Chem.* 17. *Abt.B.* 6. *pp.* 429–456, *June*, 1932.—A short survey is given of the connection between optical anisotropy and the geometrical structure of a molecule, and of methods for the determination of optical anisotropy or of the optical polarisation ellipsoid [see Abstract 3314 (1929)]. The work of Placzeck is also discussed in respect to the Raman effect as a means of investigating molecular structures. By means of a suitable apparatus, the Kerr constants of the following vapours at high temperatures have been measured: $SnCl_4$, C_6H_6, $CHCl_3$, $C_2H_4Cl_2$, *cis* and *trans* $C_2H_2Cl_2$, C_3H_7Cl and $CH_3COC_2H_5$. The polarisation ellipsoids of these molecules have been evaluated, and in some cases the structures derived, *e.g.*, $SnCl_4$ appears to possess the tetrahedral structure; *n*-propylchloride cannot have a plane configuration, since very strong rotation of the CH_3–bond is indicated; and nitrous oxide has the unsymmetrical configuration NNO, and not the angular form  $\overset{\diagup O \diagdown}{N{=}N}$. H. H. Ho.

4242. Optical Anisotropy of Argon and Methane Molecules. S. Parthasarathy. *Indian Journ. Phys.* 7. *pp.* 243–249, *July*, 1932.—With a high-speed camera specially constructed for this work, the transversely scattered radiations from the gases argon and methane, excited by light polarised with electric vector parallel to the direction of observation were examined for polarisation with a quartz double-image prism. In each case the scattered light was found to be unpolarised, thus establishing definitely that these molecules oscillate as anisotropic electric dipoles in the field of the light wave. If the atom radiates also as a magnetic dipole or an electric quadripole, the contribution from it to the observed scattering is too small to be observed. An explanation is advanced tentatively, that this observed optical anisotropy might arise from atoms and molecules temporarily springing up into the excited state; the normal and the excited states being optically different. AUTHOR.

4243. Comparison of Light Diffused with Light Transmitted by Turbid Media. A. Boutaric. *Rev. d'Optique*, 11. *pp.* 145–155, *April*, 1932.—Theoretical considerations show that the numerical values given by nephelometers for light scattered by solutions, whatever their qualitative value in the study of suspensions, colloids, etc., may be, have no simple quantitative significance. In particular, there is no proportionality between the variation of diffusion coefficient of a medium and that of its absorption coefficient or optical density. Measurements on suspensions of mastic give a curve relating optical density to intensity of light scattered at right-angles to the incident beam which is in exact agreement with the theory. C. B. A.

4244. Dependence of the Scattering of Light in Aerosols on the Size of the Particles and the Wave-Length of Light. I. D. Gurewitsch and G. P. Lutschinsky. *Kolloid Zeits.* 60. *pp.* 24–34, *July*, 1932.—Various aerosols are produced by burning tobacco, sodium and so forth. The experimental arrangements for finding the brightness of the Tyndall cone and the density of the concentration are explained, diagrams of these and micro-photographs of the particles are also given. The intensity of the scattered light for constant wave-length in the aerosol is given by one of the formulæ $J = Knd^2 (a)$ or $J = Knd^3 (b)$. Dense spheres such as aerosols of tobacco obey (*a*), and magnesium which forms an aggregate obeys (*b*). The relation between intensity and wave-length may be written in general as $J\lambda^n$ = constant, where n is 2 or 4 according to the kind of particle. H. M. B.

4245. Reciprocal Theorem in the Theory of Diffraction. F. D. Smith. *Phil. Mag.* 14. *pp.* 66–78, *July*, 1932.—The paper deals with the problem of calculating a source of sound which will produce a specified distribution of velocity potential in a medium. It is suggested that the method employed has a possible application to the problem of calculating an aerial array which will produce a specified angular distribution of electromagnetic radiation. W. E. P.

4246. Possibility of a Compton Effect in Optics. F. Wolfers. *Comptes Rendus*, 194. *pp.* 2202–2204, *June* 20, 1932.—It is shown that a change of frequency is produced whenever a luminous ray changes direction at the surface of separation of two media, and this effect should be rigorously zero when there is reflection or refraction according to the laws of Descartes. The fundamental laws of geometrical optics may therefore be expressed in purely quantum language as: the trajectories of photons are reflected or refracted at the surface of separation of two media so that the frequency of the photons remains invariable. Any difficulty due to the Compton effect in interference phenomena will be thereby obviated. H. H. Ho.

4247. Optical Wave Studies of a Microscope Objective. K. Strehl. *Zeits. f. Instrumentenk.* 52. *pp.* 299–307, *July*, 1932.—The author gives the results of a series of tests made to determine for a DD-Zeiss microscope objective the wave surfaces and error curves, using the wave-lengths 656, 546, 486 and 434 $\mu\mu$. The results are shown in a series of graphs and tables, together with a series of results obtained in practical use. R. S. R.

4248. Stationary Value of Axially Symmetric Functions. Part II. T. Smith. *Optical Soc., Trans.* 33. 5. *pp.* 234–235, 1931–1932.—The author makes a correction and addition [see Abstract 1242 (1928)].

4249. Determination of Defects in Flatness of Surfaces. A. Biot. *Ann. Soc. Sci. de Bruxelles*, 52. *pp.* 54–58, *June* 8, 1932.—A comparison of two surfaces is made by selecting two points along a line for each surface. With these surfaces facing one another and using an interference method with transmitted monochromatic light, the distance apart of successive fringes is found. This process can be continued across the surface. A precision of λ/200 can be readily obtained. The process can be used to determine the three principal radii of curvature of a body. R. S. R.

4250. Testing of the Parallelism of the Planes of Plates. C. Münster. *Phys. Zeits.* 33. *pp.* 505–509, *July* 1, 1932.—Full details are given of an arrangement for testing the parallelism of the surfaces of plates which while accurate can be carried out with ordinary apparatus on an optical bench. The method depends on interference principles, and with modifications the apparatus can be used for interferometer measurements. J. J. S.

4251. Parallel Plate Micrometer. T. Y. Baker. *Optical Soc., Trans.* 33. 5. *pp.* 209–213; *Disc.*, 213, 1931–1932.—A parallel plate of glass placed in the convergent beam of a reading microscope is a useful means of obtaining the "fine-reading" of a divided circle. The fine-reading scale is uniform if its length is proportional to the tangent of the angle through which the plate is tilted and if the refractive index of the glass is 1·60. AUTHOR.

4252. Multiplex-Interference Spectroscope. E. Pauls. *Phys. Zeits.* 33. *pp.* 405–410, *May* 15, 1932.—The possibilities are investigated of increasing the resolving power of the Fabry étalon by the use of two or more plates behind each other, as in the multiplex-interferometer. C. B. A.

4253. Interference Refractometer. W. E. Williams. *Phys. Soc., Proc.* 44. *pp.* 451–461; *Disc.*, 461–464, *July* 1, 1932.—The importance of accurate refractive-index measurements in relation to spectroscopy is emphasised and the various methods hitherto employed are compared. A new type of interferometer is described in which the beam from the central part of the collimator objective is divided and each half laterally displaced. After passing through the gas tubes, the beams are again reunited so that the interference pattern at the focal plane of the telescope objective is similar to that from a two-plate transmission échelon. The brightness of the fringes is approximately twenty times greater than with the usual Rayleigh interferometer, so that the instrument can be combined with a spectrograph for dispersion measurements. A new method, based on Benoît's "fractional-part" principle, is developed for this purpose. AUTHOR.

4254. Construction and Tests of a Quartz Monochromator. L. J. Heidt and F. Daniels. *Am. Chem. Soc., J.* 54. *pp.* 2384–2391, *June*, 1932.—Description of a monochromator for the investigation of photochemical reactions in the ultra-violet. An automatic device keeps the 60° prism at minimum deviation and in the centre of the field, whilst the telescope is also kept in focus automatically. Tests show that for any wave-length setting approximately 98% of the radiation falls within a range of 10 to 20 $m\mu$. A. H.

4255. Achromatic Wedge Free from Reflection. N. Günther. *Zeits. f. techn. Physik,* 13. 7. *pp.* 308–310, 1932.—A simple formula is found for an achromatic wedge which is free from reflection. Such an arrangement is limited to small angles of dispersion, since only under such conditions is reflection eliminated. When this condition is fulfilled the achromatism extends over a wide range of wave-lengths as shown by a numerical example. H. M. B.

4256. Apparatus for Optical Studies at High Pressure. T. C. Poulter. *Phys. Rev.* 40. *pp.* 860–871, *June* 1, 1932.—The selection of materials for the construction of high-pressure equipment is discussed. Simplified piston packing, electrode insulation, temperature control and a compact and safe type construction of pressure equipment is described with particular reference to systems for optical studies at high pressures. Equipment for optical studies at pressures as high as 30,000 atmospheres and some of their limitations and peculiarities are described. [See following Abstract.] AUTHOR.

4257. Lens Effect of Pressure Windows. T. C. Poulter and C. Benz. *Phys. Rev.* 40. *pp.* 872–876, *June* 1, 1932.—The lens effect of high pressure optical systems involving glass or quartz windows has been studied and found to be due to four primary causes. (1) Pseudo-lens effects due to temperature gradients following changes of pressure. (2) Bulging of the outer surface of the pressure window. (3) Pseudo-lens effect due to unequal distribution of strain in the window. (4) The difference in index of refraction of the material in the cylinder and that of the window combined with the bulging of the inside surface of the window. These effects are measured and methods for their correction outlined. [See preceding and following Abstracts.] AUTHORS.

4258. Permeability of Glass and Fused Quartz to Ether, Alcohol and Water at High Pressure. T. C. Poulter and R. O. Wilson. *Phys. Rev.* 40. *pp.* 877–880, *June* 1, 1932.—The permeability of glass and fused quartz to water, alcohol and ether and its relation to pressure windows has been studied. These liquids are shown to penetrate to considerable depths if the pressure is maintained for as long as fifteen minutes, in which case the pieces of glass or quartz are shattered if the pressure is rapidly released. However, if the pressure is released over a period of several days little or no breakage occurs. It is, therefore, likely that much of the difference in the behaviour of pressure windows as different liquids are used in contact with the windows is due to their ability to penetrate the glass or quartz. [See preceding Abstract.] AUTHORS.

4259. Capillary Mercury-Vapour Lamp. F. Daniels and L. J. Heidt. *Am. Chem. Soc., J.* 54. *pp.* 2381–2384, *June*, 1932.—A complete description is given of a water-cooled quartz-mercury-vapour lamp from which a very high intensity is obtainable. The lamp is very suitable for use with a monochromator. A. H.

4260. Mercury-Vapour Lamp for Laboratory Use. I. Balinkin and D. A. Wells. *Rev. Sci. Instruments*, 3. *pp.* 388–391, *July*, 1932.—Describes an inexpensive lamp made from pyrex and evacuated. It is operated on d.c. at 60–120 volts and 1 ampere. Constrictions in the limbs retain mercury above the tungsten electrodes when the lamp is tilted to start, so that the arc strikes between mercury and mercury. The lamp usually starts at the first tilt and maintains a steady current practically indefinitely. Two lamps on life test have been burning for more than 4000 hours without serious blackening. J. E.

4261. Recording Microphotometer using a Photoelectric Cell and Thermionic Valve Amplifier. G. Todesco. *N. Cimento*, 9. *pp.* 138–149, *May*, 1932.—Full details are given of the apparatus, and typical photographs of the mercury-arc spectrum, the Raman spectra of water, *d*-pinene, and glycerol, and of a grating with 100 lines per mm. are reproduced and described. H. F. G.

4262. Correction for Slit-Width in Spectrophotometry. G. Ribaud and I. Peychès. *Rev. d'Optique*, 11. *pp.* 241–256, *June–July*, 1932.—In order to reduce spectrophotometric measurements made with a finite slit-width to those which would be obtained with an infinitely narrow slit, a correction factor must be applied, especially where the rate of change of intensity with wave-length is rapid. If λ_0 be the wave-length corresponding to the centre of the slit, the measurement made depends on the spectral width of the slit a and corresponds to a measurement made with an infinitely narrow slit at wave-length $\lambda_0 + \Delta\lambda$ where $\Delta\lambda = \frac{1}{8}(b_1 + v_1)a^2$. In this formula b_1 represents the gradient of the spectral distribution curve of the light measured, and v_1 the gradient of the visibility curve of the eye, both at the wave-length λ_0. If the spectral distribution curve of the light is such that it cannot be regarded as linear over the range covered by the slit, a more elaborate correction formula must be used. The authors also consider the further practical case in which the measurement is that of the ratio of the brightnesses of two sources at some wave-length. In this case the true ratio N_0 corresponding to the wave-length λ_0 is connected with the measured ratio N by the formula $(N_0 - N)/N = \frac{1}{8}a^2(\beta^1 - \beta)$, where β^1 and β respectively represent the curvatures of the spectral distribution curves of the two sources. J. W. T. W.

4263. Photographic Action of Slow Electrons. R. Whiddington and J. E. Taylor. *Roy. Soc., Proc.* 136. *pp.* 651–662, *June* 1, 1932.—Slow electrons (60–300 volts) are deflected away from stray electrons by passing them through a magnetic field produced by a solenoid and then impinge upon photographically sensitive film. Standardised development conditions were used and the density of the produced images measured. Readings were found to be readily repeatable and the usual empirical formula, *viz.*, $D = \gamma \log It^p - i$, was found to hold (D = density, measured logarithmically; I = electron current in amperes $\times 10^{-8}/\text{cm.}^2$; t = time of exposure in seconds; i = inertia of plate; p = Schwarzchild's constant; γ = a constant depending upon the experimental conditions). The value of i may be increased by oiling the film. The effect of varying the electron velocity is also determined and the constants are found to be independent of the velocity in the range considered. The following values for the constants are given as a result of the experiments: $p = 0{\cdot}88$, $i = 0{\cdot}47$, $\gamma = 0{\cdot}31$ for the untreated film, and $p = 0{\cdot}90$, $i = 0{\cdot}17$, $\gamma = 0{\cdot}27$ for film which has been oiled. J. E. R. C.

4264. Partial Solution of Integral Photography. J. de L. Saint-Genies. *Comptes Rendus*, 194. *pp.* 2045–2046, *June* 6, 1932.—A simple apparatus is described for obtaining on the same plate multiple stereoscopic effects directly observable at the distance of distinct vision. H. H. Ho.

4265. Calibration of Two Photographic Plates. S. Arend. *Comptes Rendus*, 194. *pp.* 2292–2294, *June* 27, 1932.—The mathematical solution, by the use of projective geometry and trilinear coordinates for points on either plate, of the problem of adjusting the scale of a given plate with that of some standard plate. G. C. McV.

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4266. Analysis of Photographic Emulsions for Non-Halide Silver and Soluble Bromide. B. H. Carroll and D. Hubbard. *Bureau of Standards, J. of Research*, 8. *pp.* 711–727, *June*, 1932.—This paper is a critical study of methods proposed for the determination in emulsions of silver in forms other than silver halide, and a description of a new method of extracting soluble bromide from emulsions. The method of Weigert and Luhr, based on double fixation with thiosulphate, is found to be reliable; the principal danger is decomposition of silver thiosulphate to sulphide. The method of Schmidt and Pretschner, direct extraction with nitric acid, is too insensitive. Soluble bromide may be quantitatively extracted from plates by three changes of dilute acid; error from formation of silver-gelatin complex is thus eliminated. Electrometric titration at pH2 or less may be used for liquid emulsions, and is preferable for analysis of plate extracts, but it is also possible in the latter case to determine the bromide by oxidation to cyanogen bromide, with subsequent iodometric titration, according to Lang. AUTHORS.

4267. Light-Sensitive Surface Films. Part II. F. Weigert and E. Eberius. *Kolloid Zeits.* 60. *pp.* 13–23, *July*, 1932.—Further experiments are described in connection with the effect of light on photographic films [see Abstracts 2816 and 2817 (1932)]. Very thin silver-halogen films of thickness estimated at 700 Å. are considered. When slowly dried the film is particularly sensitive to red light, and the metallic silver formed during development shows a strong mirror effect; these silver particles are not originally in the surface film, but are carried there by liquid diffusion from lower layers. When a surface film is sensitive to red light it has a blue colour. By interference phenomena, there results on the underside of the film a second mirror layer which cannot be washed off. These phenomena are probably molecular effects which play a very important part in photography and photoanisotropy. H. M. B.

4268. Silver Grain Theory of the Latent Image. Part I. Critical Grain Size. W. Reinders and L. Hamburger. *Zeits. f. wiss. Phot.* 31. *pp.* 32–53, *June*, 1932.—A method of depositing subatomic layers of silver 10^{-3} to 10^{-1} atom thick from a vapour stream is described, and the capacity of these layers for subsequent development with hydroquinone to which a 0·25 % silver nitrate solution has been added is investigated. It is found that the atoms in these sublimates on glass are deposited at random. The lower limit for developability is from 0·001 to 0·005 atom thick. Isolated atoms and atom pairs are not developable, but silver aggregates of 3 or 4 or more atoms on quartz or glass are active as nuclei. With increasing thickness of the layer a reversal effect is encountered which appears to be purely physical in nature depending on differences in the structure of the primary and secondary layers. The lower for reversal is about 0·01 atom thick. Solarisation of the photographic plate is explained on these lines. J. E.

4269. Latent Image and Physical Development. Part II. H. Arens. *Zeits. f. wiss. Phot.* 31. *pp.* 68–76, *June*, 1932.—It has previously been shown [see Abstract 1015 (1930)] that the amount of silver obtained by physical development of an Ag gelatinosol depends upon the dispersity of the latter. More generally, it is now shown that for a given superficial density of the disperse Ag, the Ag obtained on physical development (for a standard time) increases with increasing dispersity and, at a given number of nuclei per cm.^{2}, the amount of physically developed Ag is independent of the mode of preparation of the sol, being the same even for gelatinosols of Au and of Ag_2S of the same dispersity. From the form of the curves relating quantity of physically developed Ag to the number of sol-particles per cm.^{2}, it is concluded that the physically developed grains are smaller the greater the number of sol-particles per cm.^{2}. The preparation of the sols is described. [For Part I see Abstract 4178 (1931).] L. V. C.

4270. New Equation for the Rate of Formation of the Photographic Latent Image. J. M. Blair and P. A. Leighton. *J. Phys. Chem.* 36. *pp.* 1649–1654, *June*, 1932.—A differential equation, $dx/dt = k_1x(b - x)/2 - k_2x$, where x is the developable density, t the time of exposure to light of constant intensity, and b the ideal maximum density, has been derived from definite theoretical postulates and found to agree with the experimental data obtained from measurement of the density-exposure relationships on very thin emulsions. H. H. Ho.

4271. Development of Fine-Grain Images. A. Lumière and A. Seyewetz. *Soc. Franç. Phot. et Ciné., Bull.* 19. *pp.* 36–47, *Feb.*, 1932.—For fine-grain images in rapid negative emulsions the authors find development with paraphenylene diamine, rendered alkaline with trisodium phosphate, superior to metol-hydroquinone plus borax, and only excelled in certain cases by physical development after fixation. The greyish dichroitic image obtained may be improved without growth of grain by use of a chlorochromic intensifier. The selected formula is:—water, 1000 c.c.; paraphenylene diamine, 10 gm.; anhydrous sodium sulphite, 60 gm.; trisodium phosphate (10 % solution), 20 c.c.; potassium bromide (10 % solution), 10 c.c.; develop 1 hour at 17°–18° C. L. V. C.

4272. High-Frequency Limitations of the Kinematograph. H. v. Schardin. *Soc. Franç. Phot. et Ciné., Bull.* 19. *pp.* 76–82, *April, and pp.* 106–112, *May*, 1932.—A discussion of the difficulties met with in obtaining continuous photographic records of phenomena involving high frequencies (of the order of 100,000 per sec.). Photographic, optical and mechanical difficulties are all considered, and some of the attempts which have been made to overcome these are discussed. A. H.

4273. Short Exposure High-Intensity Sensitometer. G. Mareschal. *Soc. Franç. Phot. et Ciné., Bull.* 19. *pp.* 124–132, *June*, 1932.—The exposures used for the sound track in the sound picture record are essentially of high intensity and short duration. Sensitometric determinations of the constants of the emulsion should be made under similar conditions. The apparatus described is for this purpose. The exposure of 1/20000 sec. is made by a rotating shutter; driven from the same mechanism is a rotating stop which reduces the amount of light in a preselected manner over a series of exposures. A fresh piece of film is brought into place for each exposure by an ordinary kine-camera mechanism operated from the same drive. The paper concludes with a discussion of the results obtained and their importance in sound-film technique. F. S. B.

4274. Relations between Types of Luminescence. E. L. Nichols and Frances G. Wick. *J.O.S.A.* 22. *pp.* 357–368, *June*, 1932.—The similarity of observed spectra in candoluminescence and kathodoluminescence suggests the same process. It is the purpose of this paper to describe further experiments supporting this view. Oxides of thorium, calcium or lanthanum, with known amounts of rare earth impurities were used and subjected to H flame excitation, ultra-violet excitation and kathode bombardment. The results of spectral analysis are given in tables, showing the similarity of the spectra. It is suggested that luminescence in general is an accompaniment of oxidation or similar process. J. E.

4275. Phosphorescent Sulphides. Extinction Action of Metals of Iron Group. M. Curie and J. Saddy. *Comptes Rendus*, 194. *pp.* 2040–2042, *June* 6, 1932.—Working with phosphorescent ZnS it has been found that addition of Fe-group metals diminishes the luminescence and at the same time, and in a non-parallel manner, the photo-conductivity, Co being the most active. It is considered that the extinction of luminescence is due to the fact that the added ions have an excitation frequency very near to the excitation frequency of the luminescent centres. J. E.

4276. Spectrum of Exciting Absorption in Lenard Phosphors. R. Kühner. *Ann. d. Physik*, 13. 8. *pp.* 873–904, *June* 20, 1932.—These phosphors show with increasing temperature a bigger drop in the shorter wave maxima than the longer. With increasing metal content the ultraviolet excitation decreases, and the smaller the metal content the further into the ultra-violet lies the maximum of excitation for a given band complex. Selective maxima exist for the rapidly decaying phosphorescence as for the durable phosphorescence. The general rule that analogous bands of emission have practically the same distribution of excitation, whatever the active metal or base, is confirmed, as are the general conclusions of F. Schmidt [see Abstract 1955 (1932)] that, (1) there is a series arrangement of the excitation bands, (2) overlapping of several series occurs, and (3) the emission bands belong to the same series as the absorption, the former being the continuation of the latter. J. E.

4277. Effects of Temperature and Nitrogen Pressure on the Afterglow of Mercury Resonance Radiation. E. W. Samson. *Phys. Rev.* 40. *pp.* 940–963, *June* 15, 1932.—Measurements are made of the rate of decay of the λ2537 afterglow from an optically-excited quartz cell containing mercury vapour and nitrogen at temperatures of 301°, 374°, and 486° K. The work is done with a rotating-disc phosphoroscope so designed that two traces representing the decay of the afterglow are recorded on a photographic plate. The exponential decay constants range from 300 to 12,900 sec.^{-1}. A striking result is a very rapid increase of the decay coefficient with rise of temperature at high pressures. The rate of decay depends on the rates at which collisions with nitrogen molecules cause transitions of the mercury atom between the 2^3P_0 and 2^3P_1 states and possibly from either of these states to the normal state, on the rate of diffusion of metastable 2^3P_0 atoms to the walls of the vessel, and on the imprisonment of λ2537 radiation by successive absorptions and re-emissions of quanta before they escape from the cell. A. H.

4278. New Source of Light for Excitation of the Resonance Fluorescence of Metallic Vapours, Especially Mercury. F. G. Houtermans. *Zeits. f. Physik*, 76. 7–8. *pp.* 474–480, *June* 20, 1932.—The various sources are referred to, in particular the device of Cario and

Lochte-Holtgreven [see Abstract 2506 (1927)], in which the self-reversal of the resonance lines is avoided by discharge in a dilute mixture of the metal vapour with a rare gas which streams through all the time. A new lamp is described, which consists of an oxide-kathode discharge tube containing argon, to which is attached a side tube containing Hg which may be heated. To avoid self-reversal of the resonance lines the emitting part of the tube is flattened to a width of only two millimetres. A comparison with a Heraeus lamp cooled and in a magnetic field showed that the resonance line from the new lamp is 40–50 % stronger. The new lamp was also shown to be constant to 2 % over two hours and has been run already for over 200 hours. A Mg lamp is also briefly described.
J. E.

4279. Absorption of the Resonance Line 2537 A. in Mercury Vapour. H. Magliano. *Zeits. f. Physik*, 76. 11–12. *pp.* 793–798, *July* 12, 1932.—The apparently contradictory results of many workers on the absorption of the resonance line in mercury vapour are really complementary to each other. The contradictions arise out of the way in which the maximal absorption coefficient is calculated from the measured total absorption. An extrapolation formula is given which shows that the value of Kunze [see Abstract 2376 (1928)], $k = 5 \cdot 78 \pm 0 \cdot 13$ cm.$^{-1}$, is a lower limit for the effective absorption coefficient for the middle of the line at 20° C.
J. E.

4280. Fluorescent Excitation of Mercury by the Resonance Frequency and by Lower Frequencies. Part IV. (Lord) Rayleigh. *Roy. Soc., Proc.* 137. *pp.* 101–116, *July*, 1932.—Deals with " core " effect, *i.e.*, fluorescent excitation by resonance line. It is shown more clearly than in previous work [see Abstract 3247 (1932)] that the resonance fluorescence behaves differently from the other components. It can, except at low pressures, diffuse itself independently of and against the vapour stream—unlike the visual fluorescence. It is proved by direct experiment that the visual fluorescence is associated with metastable atoms of kinds 2^3P_0 and 2^3P_2 which are provisionally regarded as supplying the energy for the persistent luminosity. The resonance luminosity contains only 2^3P_1 atoms, and the persistent luminosity in this case is attributed to " imprisonment of radiation." The complete line spectrum is produced by the resonance line *only*, and thus the phenomenon differs from the line spectrum excited by successive absorptions as investigated by R. W. Wood. This line emission increases in intensity much more rapidly than the exciting intensity and appears to be indifferent to an electric field.
J. E.

4281. Fluorescence of Formaldehyde. Excitation Conditions and Analysis of Vibration Numbers. G. Herzberg and K. Franz. *Zeits. f. Physik*, 76. 11–12, *pp.* 720–728, *July*, 1932.—By excitation with a carbon arc formaldehyde gives a fluorescence with a very simple spectral structure. The shortest fluorescent band coincides with the longest wave absorption band. This suggests the two frequencies 1713 and 1023 cm^{-1}. as the ground levels, as are found in the Raman spectra. A formula is given for the bands. The coupling term between the two states is rather large. The first vibration is probably that of C = O, the second that of the tranverse vibration of the H atoms. Suggestions are also given for the interpretation of the usual bands.
J. E.

4282. Predissociation in the Spectrum of Iodine Chloride. W. G. Brown and G. E. Gibson. *Phys. Rev.* 40. *pp.* 529–543, *May* 15, 1932.—Spectroscopic evidence is provided by a new absorption band series in the near ultra-violet that the dissociation products are normal atoms. The upper level of the ordinary system is now interpreted as a $^3\Pi_1$ state. The 3,1, 2,0 and 3,0 bands of a new system (system 2) have been analysed and furnish rotational constants for the normal state which are in good agreement with Curtis' and Darbyshire's results from system 1 [see Abstract 2269 (1931)]. The upper electronic state appears to be derived from normal iodine and excited chlorine atoms, and its existence is confirmation of Mulliken's theory of the halogens. The 4,1 and 4,0 bands of system 2 appear as continuous except for certain lines, and at this point a new series of closely spaced vibration levels begins giving rise to faint and diffuse band heads (system 3) which converge to give normal iodine and excited chlorine as dissociation products. These phenomena can be explained by assuming that the predissociation which sets in sharply at above the $v = 3$ level of system 2 ($^3\Pi_{0^+} \leftarrow {}^1\Sigma$) is due to interaction with a repulsive O^+ state derived from two normal atoms and that at the intersection of the potential energy curves a new set of levels originates—system 3. In absorption, transitions to this new O^+ state result in sharp lines only where the rotational levels coincide with predicted levels of the $^3\Pi_{0^+}$ state. This is interpreted as due to momentary existence of the molecule in the $^3\Pi_{0^+}$ state, followed by either predissociation or by radiationless transition into the new O^+ state. [See following Abstract.] J. E.

4283. Theory of Magnetic Quenching of Iodine Fluorescence and of Λ Doubling in $^3\Pi_0$ States. J. H. van Vleck. *Phys. Rev.* 40. *pp.* 544–568, *May* 15, 1932.—A theoretical basis for Turner's suggestion [see Abstract 1202 (1931)] that the magnetic quenching of iodine fluorescence is a predissociation phenomenon. The possibility of magnetic predissociation in other molecules is discussed, and a mechanism is furnished for Brown and Gibson's interpretation of the predissociation of ICl [see preceding Abstract]. The writers previous formulæ for the width of Λ doublets in $^3\Pi_0$ states are extended to include investigation of the sign of the doublet and the perturbations from $^1\Sigma_1{}^5\Sigma$ states. J. E.

4284. Intensities in Fluorescent Spectrum of Iodine. I. I. Agarbiceanu. *Comptes Rendus,* 195. *pp.* 123–125, *July* 11, 1932.—In the series excited by λ5461 [see Abstract 3724 (1932)] the terms +2 and −4 have since been discovered, but −3 is still absent. The wave-lengths of −4, −2, and +2 are respectively 5223, 5339 and 5585 Å. The intensities of these lines are affected by some cause other than temperature—possibly by the perturbation in the initial distribution of the molecules in the unexcited state caused by absorption and re-emission. C. A. S.

4285. Absorption Spectra of Cobalt Chloride. O. Specchia. *N. Cimento,* 9. *pp.* 164–167, *June,* 1932.—A study was made of the absorption spectra of alcoholic solutions of $CoCl_2$. It is shown how the characteristic band of absorption may be resolved into a certain number of vibrational components approximately multiples of the same fundamental frequency. Verification was made of the alternate distribution of the intensity in the various components of each separate band, and besides there was shown an alternation in the distribution of the components depending on the position even or uneven that the solvent occupies in the series of the alcohols. J. J. S.

4286. Absorption Spectrum of Anhydrous Ferric Chloride. F. I. G. Rawlins and C. P. Snow. *Zeits. f. Krist.* 83. *p.* 41, *July*, 1932.—The above compound shows sharp selective absorption in the visible region at $\lambda = 6200$ Å. [For crystallographic data see Abstract 4077 (1932).] F. I. G. R.

4287. New Lines in the Absorption Spectra of the Alkalies. S. Datta and B. Chakravarty. *Indian Journ. Phys.* 7. *pp.* 273–282, *July*, 1932.—Absorption spectra of K, Na and Rb have been photographed at moderate pressures. Besides the absorption lines of the principal series some new lines on both sides of the former have been observed. The difference in wave-number between these lines and the corresponding principal absorption lines agrees fairly well with the difference in the vibration levels of the molecules expressed in wave-numbers. The new lines can be expressed by an equation of the type

$$\nu_n = [{}^2S_{1/2} - m^2P_{3/2,\,1/2}] + \Delta\nu$$

where $\Delta\nu$ measures the difference in wave-number corresponding to the various vibrational transitions of the molecules. A tentative explanation is given. AUTHORS.

4288. Absorption Spectra at High Pressures and at Low Temperatures. Transparency of Argon and Methane. B. J. Eiseman, Jr. *Am. Chem. Soc., J.* 54. *pp.* 1778–1782, *May*, 1932.—Apparatus is described for the examination of the absorption spectra of liquefied gases in the visible and ultra-violet regions, the spectra being registered with a Hilger E1 spectrograph. Argon and methane are found to be transparent at high concentrations in the spectral range under consideration. [See following Abstract.] A. H.

4289. Transmission of Liquid Carbon Dioxide. B. J. Eiseman, Jr., and L. Harris. *Am. Chem. Soc., J.* 54. *pp.* 1782–1784, *May*, 1932.—The absorption of liquid carbon dioxide is determined by means of the method used for argon and methane [see preceding Abstract]. A 1·5 cm. layer at −51° C. is found to be completely transparent in the visible and ultra-violet whilst a 16·35 cm. layer at room-temperature is also found to be transparent save, perhaps, for a slight continuous absorption below 2500 Å. A. H.

4290. Theory of the Absorption Spectra of Solid Bodies. R. Peierls. *Ann. d. Physik*, 13. 8. *pp.* 905–952, *June* 20, 1932.—An investigation is made of the mechanism which gives rise to the broadening of the spectral lines of solid bodies as compared with atomic lines. The Schrödinger equation for an excited electron state is developed for the simplest special case of solid body. This equation can have two widely different forms, one of which corresponds to a substance which acts as an absorber and the other to a substance which acts as a scatterer of radiation. In the case of a scatterer the mechanism of line broadening and the form of the absorption lines are more closely investigated. In the case of an absorber a formula for the line broadening is found according to which the broadening is proportional to the square root of the thermal energy. The line displacement is proportional to the thermal energy, but the factor of proportionality is so small that in general the displacement lies within the line width. An approximation method of calculation is given which applies especially to the case where like atoms are widely separated from one another. The results are discussed with reference to a series of experimental investigations. J. E. K.

4291. Absorption of Short Electric Waves in Ionised Gases; Attempt to Prove the Existence of Long-Wave Transitions in the Spectrum of the Hydrogen Atom. H. Klumb. *Phys. Zeits.* 33. 445–447, *June* 1, 1932.—When short electric waves, λ3 to 30 cm., are passed through an ionised gas there exists besides the continuous absorption a selective absorption of characteristic frequencies (plasma-vibrations) whose spectral position varies with the ion density. In the case of hydrogen there exists the further possibility that the normal atom can absorb discrete wave-lengths in this region, since, assuming validity of the ordinary selection rules, the electron transitions $2P_{3/2}$–$2S_{1/2}$, $3P_{3/2}$–$3S_{1/2}$ and $3D_{3/2}$–$3P_{1/2}$, $3D_{5/2}$–$3P_{3/2}$ correspond to wave-lengths of 2·74, 9·25 and 24·75 cm. respectively. If these transitions are actually present they should lead to discrete absorption whose spectral position is, unlike the plasma absorption, independent of ion density. Absorption experiments in nitrogen and oxygen have shown only continuous absorption, but in hydrogen selective absorption maxima at 3·9 cm. and 28 cm. are found; their position is independent of current strength. It is thought that these absorption maxima are caused by the long-wave transitions of the hydrogen atom, but on account of experimental difficulties a definite proof of this is not possible. Modern methods of detection of waves in this region are too insensitive to give any hope of finding the long-wave hydrogen radiation in emission. The experiments are to be repeated with undamped electric waves, and will be extended to helium. J. E. K.

4292. Absorption Spectra of Gaseous Alkali Halides and the Electronic Affinities of the Halogens. E. Lederle. *Zeits. f. phys. Chem.* 17. *Abt.B.* 4–5. *pp.* 353–361, *June*, 1932.—The energy levels of the ultra-violet absorption maxima observed by v. Angerer and Müller enable the determination of the electronic affinities of chlorine (90), bromine (82) and iodine (73 k.cal.) by an application of the Born–Heisenberg method. By extrapolation, the electronic affinity of fluorine is found to be 95 ± 2 k.cal. These results are in excellent agreement with the Mayer and Helmholtz data obtained from the lattice energies of the alkali halides. Deviations are found with the sodium halides for which no satisfactory explanation has yet been found. The heat of dissociation of fluorine as re-determined by extrapolation is 66·8 ± 0·5 k.cal. [See also following Abstract.] H. H. Ho.

4293. Spectroscopic Determination of the Electronic Affinities of the Pseudohalogens OH and CN. E. Lederle. *Zeits. f. phys. Chem.* 17. *Abt.B.* 4–5. *pp.* 362–368, *June*, 1932.—The connection between the heats of dissociation of simple halides and the electronic affinities of the halogens is investigated. The maxima of the continuous absorption of the halides is found also to be related to these affinities. The influence of the crystallographic system upon the absorption of the metallic halides is discussed. The work required for breaking the aromatic C-Br bond is interpolated as 75 k.cal. The electronic affinities are calculated as $E_{OH} = 88 \pm 1$ and $E_{CN} = 92 \pm 2$ k.cal., and the heat of dissociation, $(CN)_2 \rightleftarrows 2CN$, as 61 ± 3 k.cal. [See preceding Abstract.] H. H. Ho.

4294. Entropy of Bromine from Spectroscopic Data. W. G. Brown. *Am. Chem. Soc., J.* 54. *pp.* 2394–2396, *June*, 1932.—The moment of inertia of bromine is sufficiently large to permit the application of the approximate summation of the rotational energy terms used by Gibson and Heitler, and by employing the fine structure [see Abstract 2839 (1932)] and band spectra constants the molal entropies of $Br_2^{79,79}$, $Br_2^{79,81}$, and $Br_2^{81,81}$ are calculated. At the melting point the value obtained for the entropy of the gas is 61·69, compared with 62·1 calculated from specific heat measurements. If the entropy of mixing of the atoms is excluded, the value at 298·1° K. is 58·63. H. F. G.

4295. Intensification of Predissociation by Collision and Beer's Law. V. Kondratiew and L. Polak. *Zeits. f. Physik*, 76. 5–6. *pp.* 386–389, *June* 7, 1932.—For a wave-length about 5430 Å., the absorption of bromine vapour is found to undergo selective intensification at high pressures, Beer's law becoming invalid. The same effect is observed when the bromine is diluted with oxygen, and it is attributed to predissociation of the Br_2' molecule. A similar intensification of absorption with pressure is also found in NO_2 in the same region of the spectrum as the predissociation discovered by Henri. C. B. A.

4296. Intensity of Infra-Red Absorption Bands. L. A. Matheson. *Phys. Rev.* 40. *pp.* 813–828, *June* 1, 1932.—An experimental method of measuring the absolute intensities of infra-red absorption bands in gases has been used in which the absorbed energy was measured directly by the volume change in the absorbing gas due to the heat evolution in it. The absorption cell was traversed by radiation from a specially constructed infra-red monochromator arranged for evacuation. The incident energy density was found through a calibrated thermocouple and galvanometer and the optical characteristics of the monochromator. Measurements were made with various path-lengths of absorbing gas. The absorption was extrapolated to zero by using a logarithmic graph which has many advantages. Line-width forms were investigated. It was found that for CO, $a = \int a_\nu d\nu$ was $1 \cdot 18 \times 10^{13}$ for the fundamental vibration band at 4·66 μ and $1 \cdot 54 \times 10^{11}$ for the harmonic. The corresponding Einstein coefficients and the amplitudes of electric moment were calculated. The results of the analysis show that the Lorentz collision broadening type of line shape satisfies the experimental data much better than other line shapes. The line widths of the fundamental and harmonic bands were observed as 0·10 and 0·12 $cm.^{-1}$ at atmospheric pressure which would arise from collision diameters of 5·5 Å. and 6·1 Å. respectively. These line widths are smaller than have been previously reported for infra-red lines.

AUTHOR.

4297. Absorption Spectrum of Water Vapour Beyond 10 μ. L. R. Weber and H. M. Randall. *Phys. Rev.* 40. *pp.* 835–847, *June* 1, 1932.—The absorption spectrum of water vapour has been remeasured in the region 10–25 μ, the dispersing agent being a 60° KBr prism with a Wadsworth-Littrow mounting. The recording vacuum spectrograph is described. The necessary amplification is obtained by means of the Moll or the Firestone amplifier. The increased dispersion of this spectrograph shows the spectrum to be very complicated in this region, and not yet fully resolved. No decision has been reached as to the nature of this spectrum, whether it is a vibration-rotation band, the near end of the rotation spectrum, or an overlapping of the two. AUTHORS.

4298. Intensity of Infra-Red Water Absorption Bands of Strong Aqueous Solutions of LiCl or $LiNO_3$. M. Neunhoeffer. *Phys. Zeits.* 33. *pp.* 439–443, *June* 1, 1932.—The influence of strong LiCl and $LiNO_3$ admixtures on the absorption of water in the two bands at 1·47 μ and 1·98 μ is investigated in dependence on the absorbing layer thickness. With a dispersion of 130 Å. and 163 Å. per slit-width respectively, the absorption law holds exactly in all cases. $LiNO_3$ displaces the centres of gravity of both bands towards shorter wave-lengths. There is strong dependence on the concentration. LiCl displaces the band at 1·98 μ as a whole towards longer waves, but the centre of gravity of the band at 1·47 μ remains unaltered. J. E. K.

4299. Infra-Red Characteristic Frequencies of Alkali-Halogen Crystals. M. Born. *Zeits. f. Physik*, 76. 7–8. *pp.* 559–560, *June*, 1932.—The method of determining characteristic frequencies by absorption as given by R. B. Barnes [see Abstract 787 (1932)] gives the true vibration frequencies of the positive-ion lattice relative to the negative-ion lattice, while the residual-ray method gives frequencies which are displaced by an unknown amount. From a comparison of his results with those calculated from theory, Barnes comes to the conclusion that the theoretical formulæ are all faulty. The author does not agree, and gives a table comparing the frequencies calculated from the formula of Born and Brody [see Abstract 936 (1923)] with those just determined by Barnes for six alkali halides, showing that the agreement is remarkably good. Further, the theory has recently been improved by Born and Mayer [see Abstract 2717 (1932)] by reconsideration of the non-Coulomb term. The author promises a recalculation of the frequencies on the basis of this paper. J. E.

4300. Attempt to Coordinate Infra-Red Absorption Bands of Certain Aromatic Compounds. J. Lecomte. *Comptes Rendus*, 194. *pp.* 2037–2040, *June* 6, 1932.—The results of analysis of infra-red absorption bands of benzene, toluene, naphthalene and xylenes. The various series of bands in each can be expressed by the formula $\nu = a + bn + cn^2$. It is shown that there are certain agreements of frequency-differences among the various ring compounds studied. J. E.

4301. Effect of Dilution and Temperature on Infra-Red Absorption Bands: Molecular Associations. R. Freymann. *Comptes Rendus*, 195. *pp.* 39–41, *July* 4, 1932.—Experiment does not confirm electrolytic dissociation as the explanation of the variations with concentration and temperature noted [see Abstract 1218 (1932)] in intensity of the hydroxyl bands in butyl alcohol, etc., solutions. They are caused by dissociation of associated molecules. [See Abstract 2414 (1932).] C. A. S.

4302. Vibration Spectra of Certain Polyatomic Molecules. R. Titeica. *Comptes Rendus*, 195. *pp.* 307–309, *July* 25, 1932.—The infra-red absorption curve of formaldehyde has been determined. The six fundamental frequencies are 2945, 1461, 520, 2945, 1768 and 917 cm.$^{-1}$. Similar measurements have been made with acetone. H. F. G.

4303. Rotational Structure of Ultra-Violet Absorption Bands of Formaldehyde. G. H. Dieke and G. B. Kistiakowsky. *Nat. Acad. Sci., Proc.* 18. *pp.* 367–372, *May*, 1932.—Preliminary results of measures of bands at 3520, 3430 and 3390 Å., almost completely resolved in third order (0·4 Å./mm.), do not confirm earlier analyses. In first approximation the simple symmetrical top model can be used; departures from this are accounted for, and will be discussed later. All branches predicted by the model have been found, and a number of specified characteristics allow an unambiguous assignment of quantum numbers. In particular, predicted intensity relations are verified. Lines from a level with even K are three times stronger than from odd K. A number of new bands have also been found. Herzberg's vibrational analysis is confirmed on some points. T. L. M.

4304. Lines of Tungsten and Rhenium Appearing in the Spectrum of the Electric Furnace. A. S. King. *Mt. Wilson Observat. Contrib. No.* 448. *Astrophys. J.* 75. *pp.* 379–385, *June*, 1932.—Metallic tungsten and rhenium were fused in the carbon-tube furnace, and the vaporisation of the resulting carbides at temperatures near 2800° C. gave spectra consisting of the low-level lines of each element. The lines listed, whose presence in the furnace is at least probable, number 75 for tungsten and 19 for rhenium in the spectral range $\lambda\lambda$2800–6700. The rhenium furnace lines, all from the first three levels assigned by W. F. Meggers, show hyperfine structure in a variety of patterns. AUTHOR.

4305. Spectral Energy-Distribution of the High-Current Vacuum Tube. J. A. Anderson. *Mt. Wilson Observat. Contrib. No.* 449. *Astrophys. J.* 75. *pp.* 394–406, *June*, 1932.—When the current density is greater than 10,000 A./cm.^{2}, a continuous spectrum appears which is independent of the material of the electrode and the residual gas. With increasing current density this spectrum at first increases very rapidly in intensity, then progressively slower, thus suggesting an approach to saturation. The intensity of the continuous spectrum at a given current density also depends on the thickness of the layer of luminous gas observed, very much as if the gas had a definite absorption coefficient. The energy-curve was determined for the region $\lambda\lambda$3400–8000. From λ4000 to λ8000 it has very nearly the form of a black-body curve for 10,000° K. The absolute intensity was measured and found to be approximately 14 times as great as that of a black body at 10,000° K. AUTHOR.

4306. Variations of Wave-Length of Rays Emitted by a Copper Arc of High Intensity. J. Gilles. *Comptes Rendus.* 194. *pp.* 2200–2202, *June* 20, 1932.—A study of the variation of wave-length of the spectral rays emitted by the different regions of an arc of great intensity demands that the current and the photographic point remain fixed during the exposure, and this is unattainable for an arc between copper electrodes owing to the too rapid fusion of the metal. An arrangement is now described for producing a steady arc between an anode of brass and a kathode of graphite, and the radiation data obtained thereby for copper are recorded. H. H. Ho.

4307. Projection of Ultra-Violet Spark Spectrum. B. K. Johnson. *Journ. Sci. Instruments*, 9. *pp.* 202–203, *June*, 1932.—The radiation from a spark between metal electrodes (cadmium is very suitable) passes through a slit and a quartz lens to a quartz prism in which the optic axis is perpendicular to the refracting edge. The spectrum thus formed is received on a fluorescent screen, which may conveniently consist of cardboard with commercial vaseline smeared on it. The screen should be curved, so as to bring all the spectrum into focus at once. The quartz prism may be replaced by two water prisms with quartz end-plates. J. H. A.

4308. Spark-in-Flame Method of Spectrographic Analysis: Mutual Effect in the Emission of Elements. R. Hultgren. *Am. Chem. Soc., J.* 54. *pp.* 2320–2328, *June,* 1932.—A solution of the sample under examination is atomised into a Bunsen burner through the flame of which a condensed discharge between tungsten electrodes is passed. An auxiliary gap and fixed resistance in the circuit prevent a breakdown at low potential by reason of the great and variable conductivity of the hot gases. An improved form of stepped rotatory sector is described. Tested by analysing a solution containing 0·01 *M* of Cu, Ag, Tl and Cd with addition of 1 *M* of Na, Cu, Ag or Hg, the amounts of Cu, Ag, Th and Cd found in presence of the additions were accurate within the usual limit of error save in presence of Na. C. A. S.

4309. Second Spark Spectrum of Sodium (NaIII) in the Extreme Ultra-Violet. J. Söderqvist. *Zeits. f. Physik,* 76. 5–6. *pp.* 316–318, *June* 7, 1932.—Measurements on the vacuum spark spectrum of NaIII in the extreme ultra-violet have established combinations with the ground terms $2s^2p^4\,{}^2P_{1,2}$. Also, combinations with the terms limited by ^3P, ^1D and ^1S, though the last give lines of small intensity. J. E.

4310. Spectra of MgIV and AlV in the Extreme Ultra-Violet. J. Söderqvist. *Zeits. f. Physik,* 76. 11–12. *pp.* 756–759, *July* 12, 1932.—Measurement of vacuum spark spectra has allowed identification of about 40 lines in each spectrum; almost all the identifications are new; in both cases the combinations go down to $2p^2P$ with $4s^2P(^3P)$. T. L. M.

4311. Band Spectrum of Sulphur Monoxide. E. V. Martin. *Phys. Rev.* 41. *pp.* 167–193, *July* 15, 1932.—The emission spectrum of SO, lying in the region 2400–4000 Å., has been photographed in the second order of a 21-ft. grating. The analysis of the rotational structure shows the system to be of $^3\Sigma$, $^3\Sigma$ type, and the various constants are evaluated, as also are the vibrational constants. The spin fine-structure is resolved in parts, and it is found that Kramer's equations for spin tripling in $^3\Sigma$ states must be modified in order to get a good fit of the data. Predissociation is observed in several bands and is assumed to be caused by a $^3\Pi$ state. If the potential energy curve for this latter state is assumed to have a shallow minimum then the varying value at which the break in the rotational terms occurs with variation in v' is explainable in terms of Oldenberg's theory of dissociation by rotation. The energy of dissociation of the normal state of the SO molecule is calculated as 5·053 volts. A. H.

4312. Spectrum of Ionised Aluminium. L. Pincherle. *Accad. Lincei, Atti,* 16. *pp.* 35–40, *July,* 1932.—Confirms by calculation the hypothesis of Shenstone and Russell with regard to the series of "perturbed" lines of ionised aluminium. E. E. F. d'A.

4313. Pressure Effects in the Secondary Spectrum of Hydrogen. W. G. Guthrie. *Roy. Soc. Edinburgh, Proc.* 52. 3. *pp.* 315–322, 1931-1932.—Apparatus is described by means of which the secondary spectrum of hydrogen can be photographed at varying pressures. Tables are given showing the manner in which the intensities of the various lines are affected. Certain groups are found to behave in a related manner, but no theoretical explanation has so far been obtained. A. H.

4314. Mean Lives of Mercury Lines $\lambda 2537$ and $\lambda 1849$. P. H. Garrett. *Phys. Rev.* 40. *pp.* 779–790, *June* 1, 1932.—The mean life of the mercury line $\lambda 2537$ was measured by the alternating voltage method previously described by Webb. The radiation was excited in a quartz tube by impact with electrons from a hot kathode. The photoelectric system was contained in a separate tube also of quartz. The photoelectric surface was zinc evaporated on a nickel plate. Measurements of the apparent life were made with diminishing mercury vapour pressures until further reduction of pressure produced no change in the measured rate of decay of the radiation. At these low pressures (below 3×10^{-4} mm., for the geometry used) the absorption and re-emission of the radiation was negligible and the true life of a single excitation process was measured. This was found to be $1 \cdot 08 \times 10^{-7}$ sec. with an estimated precision of 1 %. An absorption cell with a 1 mm. thick absorbing layer of mercury vapour was mounted so as to move in and out between the excitation and photoelectric tubes used in the above measurements. The absorption of $\lambda 1849$ was measured at pressures such that the absorption of $\lambda 2537$ was negligible. From this the atomic absorption coefficient for the main component of the line was found to be $6 \cdot 2 \times 10^{-11}$ from which the mean life of the 2^1P_1 state was calculated to be $2 \cdot 9 \times 10^{-10}$ sec. with an estimated precision of 25 %. AUTHOR.

4315. Photographic Measurement of the Life of Spectral Lines. A. Occhialini and G. M. Ranghiasci. *Accad. Lincei, Atti,* 15. *pp.* 875–876, *June* 3, 1932.—Gives a simplified method of such measurement for quantitative spectroscopic analysis. The idea is to form a group of intermittent instantaneous photographs, and to count in how many of these a given line appears. Illustrations are given. The analyses are correct within 1 %. A. D.

4316. Approximate Calculation of the 2s-, 2p- and 3p-Terms of Helium and Lithium. P. Das. *Indian Phys. Math. J.* 3. *pp.* 115–121, *June,* 1932.—Attempts to derive theoretically certain energy levels in helium and lithium. In general the method followed consists in regarding the problem of several electrons as one of mutual perturbation, and the energy values are calculated by successive approximations. Only moderate agreement is obtained between the calculated and observed term values, there being better agreement in the case of helium than of lithium. A. H.

4317. Relative Intensities of Multiplet Transitions in Complex Spectra. C. W. Ufford. *Phys. Rev.* 40. *pp.* 974–979, *June* 15, 1932.—From the wave functions of the multiplets of Slater's theory of complex spectra, the relative transition probabilities of multiplet transitions have been calculated for Russell-Saunders coupling for the electron configurations p^3s–p^2s^2, p^3s–p^4, p^2s–p^3, p^4s–p^3s^2, p^4s^2–p^5s, p^2s–ps^2, p^4s–p^5 and the quintet transitions of d^3p–d^3s. The calculated quintet transition probabilities of d^3p–d^3s are compared with the values measured in TiI. AUTHOR.

4318. Structure of the Red Lithium Line. L. Allegretti. *Accad. Lincei, Atti,* 16. *pp.* 33–35, *July,* 1932.—Describes a method of separating the lithium line 6708 Å. into its components. He uses, not the absorption spectrum like Hughes, but the radiation spectrum from an arc, one of whose terminals is mercury and lithium carbonate. At a current of 2 amperes, the line appears divided into two components 0·155 Å. apart, and a third line, much fainter than the two principal ones, appears at a distance of 0·149 Å. on the more refrangible side. The results agree with the absorption experiments but not with recent calculations.

E. E. F. d'A.

4319. Fine Structure in the Arc Spectra of Bromine and Iodine. S. Tolansky. *Roy. Soc., Proc.* 136. *pp.* 585–604, *June* 1, 1932.—The hyperfine structures of twenty-nine bromine arc lines and of sixteen iodine arc lines were examined with a Fabry-Perot interferometer. A graphical method of analysis was used in those cases where the structures were incompletely resolved. Both isotopes of Br have the nuclear moment $I = 3/2$. A simple mass isotope displacement was observed in Br of the same order as that calculated. Iodine has the nuclear moment $I = 9/2$. The fine structure interval factors have been calculated for 24 terms in Br and 17 terms in I with varying degrees of approximation. There is evidence that the simple cosine method for predicting fine structures works quite well with S electron terms, but no conclusions can be drawn about *p* terms. J. E. K.

4320. Fused Silica Étalons in the Study of Hyperfine Structure. B. Venkatesachar and L. Sibaiya. *Journ. Sci. Instruments.* 9. *pp.* 216–218, *July*, 1932.—The paper discusses the advantages of fused silica étalons in hyperfine structure analysis of spectral lines. It is shown that the temperature effect on the patterns produced by such plates is negligible as compared with that on patterns from Lummer plates either of quartz or of glass. Long exposures in photographing the patterns are thus rendered possible. The re-examination by the authors of a few prominent lines of mercury using these étalons has revealed faint satellites not previously recorded. A microphotogram showing a new satellite at $-0·154$ Å. for Hg 5461 Å. is reproduced in the original. AUTHORS.

4321. Hyperfine Structure and the Polarisation of Mercury Resonance Radiation. A. C. G. Mitchell. *Phys. Rev.* 40. *pp.* 964–973, *June* 15, 1932.—The general theory of the calculation of the polarisation of resonance radiation is discussed for the case when hyperfine structure has to be considered. The polarisation of mercury resonance radiation is computed for various orientations of electric vector and magnetic field, use being made of the hyperfine structure data of Schüler and his collaborators. The polarisation of the stepwise radiation of mercury is also calculated and the results compared with the experiments of Richter. Fair agreement between theory and experiment is found. v. Keussler's method of calculating the polarisation is discussed, and it is shown that his method leads to incorrect results. AUTHOR.

4322. Hyperfine Structure of HgI Lines in the Electrodeless Discharge. T. S. Subbaraya and T. G. S. Iyengar. *Roy. Soc., Proc.* 137. *pp.* 216–229, *July* 1, 1932.—The structure of the line 4916 of HgI is examined using as the source a h.f. electrodeless discharge. The structure found coincides with that given previously by Venkatesachar and Sibaiya. On the basis of this structure the splitting of the 6^1P_1 level is determined and the structures of λλ5790, 5769, 3663, 3654 and 3125 are explained. The structures of the lines 6123, 6234 and 6072 experimentally obtained are also given. The approximate equality of the total separations and the relatively inverted position of the levels due to the two isotopes 199 and 201 as found by Schüler and Keyston is confirmed, but the anomaly which these authors noted regarding the magnitudes of the isotope displacements and the fine intervals does not exist in the 6^1P_1 level. J. E. K.

4323. Hyperfine Structure of Lead. J. L. Rose and L. P. Granath. *Phys. Rev.* 40. *pp.* 760–778, *June* 1, 1932.—The hyperfine structure of several lines of PbI and PbII in the violet and ultra-violet regions has been determined. λλ4168, 4062, 4058, 4019, 3739, 3683, 3671, 3639, 3572, 2873, 2833, 2823, 2802 of PbI, and λλ4386, 4245, 3786, 3016, 2948 of PbII were found to have structure. λλ2663, 2614, 2613, and 2577 of PbI were observed and found to be simple. Exposures with uranium-lead showed that all of the above lines are single for Pb^{206}. It was also found from the line patterns that there is a larger abundance of Pb^{207} than Pb^{208} in uranium-lead (Belgian Congo). The hyperfine splittings of $s^3P_{0,1}$ and $p^3P_{0,1,2}$ of $Pb^{207}I$ were calculated. The centre of gravity of the Pb^{207} terms and the single Pb^{206} and Pb^{208} terms for these levels were found to fall in the order of their masses. Much larger isotope displacements were observed for PbII than for PbI. Variations in the relative intensities of certain lines of PbI with excitation conditions made it appear that there may be something wrong in the classification of some of the lines with initial levels, $d^3D_{1,2}$ and $d^3F_{2,3}$. A change of several of the line patterns was observed with a variation of voltage and temperature. AUTHORS.

4324. Hyperfine Structure of Lead. K. Murakawa. *Inst. Phys. and Chem. Research, Tokyo Sci. Papers, No.* 372. *pp.* 245–248, *July*, 1932. *In English.*—The hyperfine structures of weak lead lines are measured, and the previous results are supplemented. The existence of a new lead isotope Pb^{210} is proved. [See Abstract 1242 (1932).] AUTHOR.

4325. Light Filter for Raman Spectra. R. Bär. *Helv. Phys. Acta*, 5. 3. *pp.* 174–178, *June*, 1932.—The effect of dissolving *m*-dinitrobenzene in various solvents on the continuous background which appears with the Raman spectra of the liquids has been studied. A layer of solution in benzene which absorbs 90 % of light of wave-length 4047 Å. and more of shorter wave-length radiation absorbs only about 10 % of light of wave-length 4358 Å. The solution is non-fluorescent, and is extremely stable towards radiation. H. F. G.

4326. Raman Effect of the Ions SO_4^{--} and SO_3^{--} and Electrolytic Dissociation of Sulphuric and Sulphurous Acids. P. Fadda. *N. Cimento*, 9. *pp.* 168–179, *June*, 1932.—The Raman frequencies of the ions SO_4^{--} and SO_3^{--} and those of the acids H_2SO_4 and H_2SO_3 were investigated. For the ion SO_4^{--} were found the frequencies 460, 617, 984, 1104 cm.$^{-1}$, and for SO_3^{--} 471, 602, 984 cm.$^{-1}$. In the solutions of H_2SO_4 at strong concentrations none of the frequencies characteristic of the group SO_4^{--} appear, whilst there are present the Raman lines appertaining to the ion HSO_4^-. At concentrations lower than 25 % there appears in the spectra the line 984 cm.$^{-1}$ that is the most intense of the sulphates. The solutions of H_2SO_3 do not possess any line common with the ion SO_3^{--}, but present frequencies characteristic of SO_2 and of the group HSO_4^- that are formed by oxidation. The presence of the ion HSO_3^- in solutions of this acid is uncertain. J. J. S.

4327. Raman Spectra of a Series of Octanols. G. Collins. *Phys. Rev.* 40. *pp.* 829–834, *June* 1, 1932.—The Raman spectra of a series of nineteen octanols were obtained using Hg 4358 as the exciting line. These alcohols have structures which differ only in the relative position of a CH_3 and OH group along the side of a straight carbon chain seven atoms long. The Raman spectra consist in most cases of from seven to ten modified lines whose position and intensity vary considerably for the different compounds. A comparison of the Raman spectra and the molecular structure leads to an interpretation of most of the modified lines in terms of modes of vibration of the molecules. The lines which have been accounted for appear to be due to vibrations of the type C-H, CH_3–X, OH–X, and a C–C vibration in a plane at right angles to the length of the chain. AUTHOR.

4328. Smekal-Raman Spectra of $SiHCl_3$, $CHFCl_2$ and CF_2Cl_2. C. A. Bradley, Jr. *Phys. Rev.* 40. *pp.* 908–913, *June* 15, 1932.—The Smekal-Raman spectra of the compounds $SiHCl_3$, $CHFCl_2$ and CF_2Cl_2 have been investigated using a quartz mercury arc as the primary source. There are six frequency displacements in the case of silicochloroform all somewhat less than the corresponding displacements of chloroform. The so-called transverse hydrogen bond frequency is not observed. Eight frequencies of $CHFCl_2$ and nine of CF_2Cl_2 have been observed. The transverse hydrogen bond vibration is not observed in the former. An assignment of the observed frequencies to particular modes of vibrations is made. AUTHOR.

4329. Raman Effect and Depolarisation Factors. O. Specchia. *N. Cimento*, 9. *pp.* 133–137, *May*, 1932.—Two methods of calculating the depolarisation factors of Raman lines are described. For the Raman lines of water at 3260, 3405 and 3560 cm.$^{-1}$ the factors are 0·62, 0·52 and 0·54, in fair agreement with the results of Ramaswamy except in the case of the last-named line. H. F. G.

4330. Polarisation of Raman Lines in Crystals. J. Cabannes. *Comptes Rendus*, 194. *pp.* 2134–2136, *June* 13, 1932.—The theory previously sketched [see Abstract 2005 (1932)] is elaborated and it is shown, with a crystal of type C_{2h} as example, that if the vibrations of the incident polarised ray are parallel to an axis of symmetry of the crystal, depolarisation of light diffused perpendicularly to the incident ray is nil for rays symmetrical relative to the axis of symmetry, but complete for rays antisymmetrical thereto, or degenerate [see Abstracts 2550 (1930) and 3484 (1931)]. C. A. S.

4331. Molecular Spectra and Molecular Structure. H. Deslandres. *Comptes Rendus*, 194. *pp.* 2093–2097, *June* 15, 1932.—The author discusses further the Raman spectra of hydrogen, carbon and chlorine continuing the procedure of earlier notes [see Abstract 2858 (1932)]. He considers that in all molecules the radiation emitted is that which is common to the various possible states of the molecule under different activated states. In the interior of the molecule the component elements are not absolutely fixed but are grouped differently with variable numbers of electrons without the molecule itself being destroyed. The results are supported by much chemical evidence. For the intermolecular ionisation admitted by Urbain, a part of the C_2 and Cl_2 molecules, which may be the majority, would have two ionised atoms, but in two cases the radiation emitted is the same. **Errata,** *ibid.*, 195, p. 84, July 4, 1932. R. S. R.

4332. Scattering of Light by Liquid Helium. J. C. McLennan, H. D. Smith and J. O. Wilhelm. *Phil. Mag.* 14. *pp.* 161–167, *July*, 1932.—The scattered spectrum from liquid helium has been examined in the region 4000 to 5000 Å., using a special capillary type of mercury arc, with a view to increasing knowledge of the two forms of liquid helium. Owing to rapid bubbling, no photographs could be obtained at 4·2° K., but as the pressure was reduced, this bubbling ceased suddenly at 38 mm., the liquid became quiet, and so little light was scattered laterally that the tube appeared empty. The spectra at 2° K. showed no isolated Raman lines, but the lines are broadened, an effect attributed to rotational quantum changes of loosely bound molecules. J. H. A.

4333. Cabannes-Daure Effect and Molecular Field. A. Rousset. *Comptes Rendus*, 194. *pp.* 2299–2301, *June* 27, 1932.—The continuous spectrum surrounding the exciting line in the diffused light from liquids (Cabannes-Daure effect) is to be attributed to the molecular field round the central molecule, *i.e.*, to the field due to the doublets inside the Lorentz sphere. The intensity of diffusion is calculated from a formula derived from Rocard [see Abstract 608 (1928)]. The depolarisation is given as 6/7. Further, the length of the diffuse spectrum is calculated and it is shown that a symmetry will be observed only in anisotropic liquids. These results were tested with benzene, acetic acid, CCl_4 and ethyl alcohol. The depolarisation factor was found to be 6/7, the distribution of intensity the same for all the bodies, and asymmetry appeared only with benzene and acetic acid. J. E.

4334. Pressure Effect in Radiationless Decomposition. K. Wurm. *Zeits. f. Physik*, 76. 5–6. *pp.* 309–315, *June*, 1932.—It is shown that in the system $^1\Pi \leftarrow {}^1\Sigma$ of AlH, there follows at reduced pressures by thermal excitation a breaking-up of the band series due to predissociation. This suggests that in absorption under the same conditions the transitions ending in predissociation levels are absent. With thermal excitation the critical pressure for the breaking up of the series is appreciably lower than with electron excitation. Further, a series of vibration transitions from the two known vibration levels of the $^1\Pi$ state to higher levels of the $^1\Sigma$ state have been found. J. E.

4335. Deduction of Planck's Law of Radiation from Classical Statistical Theory Without the Use of the Quantum Hypothesis. G. Schweikert. *Zeits. f. Physik*, 76. 9–10. *pp.* 679–687, *June* 27, 1932.—A form of expression for the distribution of radiation amongst the various wave-lengths, practically identical with that of Planck, is derived by a modification of an assumption made by Rayleigh in his deduction of the distribution law. Classical statistical theory, without appeal to the quantum theory, is employed in the deduction. Einstein's law of the photoelectric effect is an immediate deduction from classical mechanical theory. J. S. G. T.

4336. Paradox Relating to the Equilibrium of Radiation. C. Putilov. *Zeits. f. Physik*, 76. 11–12. *pp.* 826–828, *July* 12, 1932.—The theory of radiation requires that the density of radiant energy in a gravitational field should be constant. On the other hand, mechanical theory requires a variation of the density with change of gravitational potential, ϕ. This apparent paradox is resolved if the refraction indices, n, of the field at points 1 and 2 in the field are related to the potentials thereat by the relation $(n_2 - n_1)/n_2 = (\phi_2 - \phi_1)/c^2$, where c denotes the phase velocity of the radiation waves. J. S. G. T.

4337. Radiation of Angular Momentum. A. W. Conway. *Roy. Irish Acad., Proc.* 41. *pp.* 8–17, *July*, 1932.—The classical equations of electrodynamics are applied to determine the angular momentum radiated by the most general type of oscillator having n poles. An expression for the " terms " in molecular spectra is deduced, and it is concluded that, excluding the consideration of fine structure, any term formula for band spectra can be obtained from the consideration of oscillators obeying the classical laws of electrodynamics. J. S. G. T.

4338. X-Ray Micrograph. S. Zeidenfeld. *Journ. Sci. Instruments*, 9. *pp.* 195–198, *June*, 1932.—An X-ray spectrograph is described suitable for examining the effects of heat and strain on metals. By using large glancing angles, it becomes unnecessary to prepare thin sections, but special arrangements are necessary, since the photographic film must lie on the same line as the X-ray tube. To overcome this difficulty, the X-ray collimator passes through the centre of the camera, which is flat, and a hole is punched in the film to permit of this. Precautions against scattered radiation falling on the film are incorporated. Accessories for holding the specimens are also described. J. H. A.

4339. X-Ray Reflection Spectrograph. H. Kersten. *Rev. Sci. Instruments*, 3. *pp.* 384–387, *July*, 1932.—Detailed working instructions for the construction of a simple X-ray spectrograph are given. J. E. R. C.

4340. Very Soft X-Ray Spectra of Heavy Elements. C. del Rosario. *Phys. Rev.* 41. *pp.* 136–140, *July* 15, 1932.—Absolute wave-length measurements by photographic methods with plane gratings (280 and 1180 lines per mm.) have been made on very soft X-ray lines of Th, Pb, Hg, Au, Ir, W and Ta. The wave-lengths range from 43·6 Å. to 104·8 Å. For Hg, Au, Ir, W and Ta doublets were observed whose probable origins are transitions within the N shell, *i.e.*, $\Delta n = 0$. These doublets fall on a smooth Moseley curve of small curvature. AUTHOR.

4341. Intensity in Continuous X-Ray Spectra. J. Bøggild. *Zeits. f. Physik*, 77. 1–2. *pp.* 100–103, *July* 19, 1932.—In order to extend the continuous X-ray spectrum to shorter wave-lengths, the author has carried out intensity measurements in the region extending from 1·4 to 0·6 Å. He used bromine or other heavy gas, and concentrated the beam as much as possible. The results are given in isochromatic curves, but must only be considered as provisional. E. E. F. d'A.

4342. " Non-Diagram " Lines of Kα-Radiation of Aluminium. E. Carlsson. *Zeits. f. Physik*, 76. 7–8. *pp.* 471–473, *June* 20, 1932.—In the neighbourhood of the $K\alpha_5$ and α_6 lines of Al, two weaker lines have been found and measured. Also with Al_2O_3 as antikathode, a further line α_7 comes out. The shift of the lines due to chemical combination is confirmed and determined. J. E.

4343. Wave-Lengths of the Tungsten K-Series Spectrum with the Double Spectrometer. J. H. Williams. *Phys. Rev.* 40. *pp.* 791–796, *June* 1, 1932.—With a Société Genovoise double spectrometer and the method devised by Compton the K-series wave-lengths of tungsten were determined from the diffraction angles in the first order from calcite. The results, corrected for slit heights and reduced to 18° C. are:

Line.	Angle.	Wave-length in XU.
$WK\alpha_2$	2° 01′ 06·3″	213·37
$WK\alpha_1$	1° 58′ 22·3″	208·56
$WK\beta_3$	1° 44′ 51·4″	184·75
$WK\beta_1$	1° 44′ 24·8″	183·97
$WK\gamma$	1° 41′ 37·7″	179·06

The wave-lengths are calculated assuming a grating constant $d = 3\cdot02904$ Å. at 18° C. The separation of α_1, α_2 agrees exactly with the energy difference L_{II}–L_{III}. The β_1, β_3 lines are easily resolved in the first order and give a separation of 0·78 XU agreeing closely with the energy difference M_{II}–M_{III}. Some remarks are made on the measurement of the natural widths of W K-series lines. AUTHOR.

4344. Two-Crystal Analysis of L-Absorption Limits of Mercury. H. L. Hull. *Phys. Rev.* 40. *pp.* 676–683, *June* 1, 1932.—An investigation of the shape and width of the L_{II} and L_{III} absorption limits of mercury has been made with the two-crystal X-ray spectrometer. Mercury was used in the liquid and vapour states and in chemical combination. The absorption limits are found to be asymmetrical. Approaching the limit from the long wave-length side, the intensity of the transmitted beam falls off rather sharply at first. This is followed by a more gradual decrease to the minimum value. The observed curves appear to bear out the suggestion by Kossel that the ejected electron may sometimes not be removed completely from the atom by the absorbed quantum, but only to an unoccupied upper level. The curves for the vapour have an over-all width of 45–50 volts. The curves for the liquid state are practically identical with the vapour curves at the long wave-length side, but fall off in intensity more slowly as the wave-length is decreased. The curves for the compounds are wider than those for the liquid and vapour and some exhibit fine structure. AUTHOR.

4345. X-Ray Absorption Coefficients in the Range 0·3 to 2·0 Å. L. H. Martin and K. C. Lang. *Roy. Soc., Proc.* 137. *pp.* 199–216, *July* 1, 1932.—Two balance methods for the measurement of X-ray absorption coefficients are described, one an ionisation, the other a photographic method. A detailed account is given of the comparison of X-ray intensities by photographic means. Absorption coefficients have been measured for Fe, Ni, Cu and Zn over a range of wave-lengths 0·3 Å. to 2·0 Å., while those of Mo, Pd, Ag and Sn have been measured over shorter ranges. The values of μ/ρ are compared with those of other observers and the value of the exponent of λ in the law of absorption is shown to be a function of λ. It is shown that for Fe, Ni, Cu, Zn, Pd, Ag the K-jump equals E_K/E_L, in agreement with the observations of Richtmeyer and Jonsson. The values of $\left(\frac{\tau}{\rho}\right)_K$ for the K-absorption of the above elements can be represented by the expression

$$\left(\frac{\tau}{\rho}\right)_K = 5\times10^{-5}\,.\,Z^5\,.\,\lambda^{7/2} + 3\times10^{-3}\,.\,Z^4\,.\,\lambda^3 + 1\cdot7\times10^{-1}\,.\,Z^3\,.\,\lambda^{5/2}$$

J. E. K.

4346. Theory of X-Ray Absorption in Molecular Gases. H. J. Groenewold. *Zeits. f. Physik,* 76. 11–12. *pp.* 766–767, *July* 12, 1932.—Kronig's theory [see Abstract 3301 (1932)] was based on the assumption that the neighbouring atom was not of the same kind as the emitting one; the author shows that this restriction is not necessary. [See also following Abstract.] T. L. M.

4347. Theory of X-Ray Absorption in Molecular Gases. H. Petersen. *Zeits. f. Physik,* 76. 11–12. *pp.* 768–776, *July* 12, 1932.—Kronig's theory [see preceding Abstract] requires a difference in absorption by an isolated atom and the same atom in a molecule, due to scattering effect by the accompanying atom in the molecule. To find the relation of molecular to atomic absorption, the scattering effect at an atom is considered on Born's collision theory. The variation of this relation as a function of the energy of the expelled electron shows maxima and minima corresponding to the observed fine structure of absorption bands by molecular gases. The possibility of determining the separation of the atoms in the molecule from these maxima and minima is considered in the light of the limited experimental evidence. T. L. M.

4348. Influence of the Type of Crystal Grating on the Fine Structure of X-Ray Absorption Bands. J. Veldkamp. *Zeits. f. Physik,* 77. 3–4. *pp.* 250–256, *July* 26, 1932.—The fine structure of the K-absorption bands investigated for the body-centred elements Fe and Cr, the surface-centred elements Co, Ni and Cu, and the hexagonal elements Ti and Zn. The fine structure is identical throughout for the same type of crystal grating. A table shows the greatest variations in the absorption coefficients for these elements. A. D.

4349. General Formula for Absorption Jumps. V. Posejpal. *Comptes Rendus,* 195. *pp.* 36–39, *July* 4, 1932.—The formula $(N_X\nu_X^2 + 2N_Y\nu_Y^2 + 2N_Z\nu_Z^2 + \ldots)/(2N_Y\nu_Y^2 + 2N_Z\nu_Z^2 + \ldots)$ for $\delta_{X/Y}$, the jump from level X to level Y, where N_X, N_Y, N_Z, . . . are the numbers of electrons in levels X, Y, Z . . . and ν_X, ν_Y . . . the critical frequencies, is deduced on the assumption that a photon only penetrates into an atom as far as the level corresponding with its quantum $h\nu$, and that accordingly only a photon of which the trajectory reaches this impermeable level can on collision transfer all its energy to the peripheral electrons. The jumps δ_{K/L_1} and δ_{L_1/M_1} thus calculated agree fairly with experimental results. [See Abstract 3486 (1931).] C. A. S.

4350. Experimental Study of the Partial Absorption of X-Rays. H. Hulubei. *Comptes Rendus,* 195. *pp.* 231–233, *July* 18, 1932.—From an analysis of monochromatic X-radiation which has passed through an absorbing medium, B. B. Ray has found frequencies present corresponding to the difference between the incident energy and the K level, *i.e.*, due to an interaction between the incident quantum and a bound electron. Unlike the Raman effect, however, the quantum, after imparting some of its energy to the electron, continues in the same direction. In this paper the author describes experiments in which the above phenomenon has been reinvestigated using C, Al, and B as absorbers and a Mo antikathode. An optimum thickness of absorber for intensity of modified radiation was used. No modified radiation was detected of the type described by Ray of greater intensity than 1/4000 of the intensity of the exciting radiation. J. E. R. C.

4351. Absorption of Scattered X-Rays. S. R. Khastgir. *Phil. Mag.* 14. *pp.* 99–112, *July*, 1932.—The difference between the penetrating powers of primary and scattered X-radiation, resulting from the so-called J-transformation during transmission of the latter through matter, is discussed, with particular reference to the case in which the difference is continuous over a wide range of frequencies. Calculations based on Ulrey's energy distribution curves for tungsten radiation at different voltages, and taking into account the heterogeneity of the radiations concerned and the presence of normal radiation in the scattered beam, show that Compton's theory of scattering is not in accord with experimental facts. Correlation of the results obtained by various workers shows that a significant feature of the J-transformation is that the difference between the ease of absorption of the primary and scattered radiations is constant. Recent work of Backhurst is briefly discussed. H. F. G.

4352. Scattering of X-Rays by Monatomic Gases. Y. H. Woo. *Tsing Hua Univ., Sci. Reports,* 1. *pp.* 135–143, *May,* 1932. *In English.*—Careful comparisons of the various theories and formulæ with reference to helium, neon and argon, with plentiful experimental detail. Wentzel's formula is more probable than Jauncey's. [See following Abstract.] A. D.

4353. Absorption and Scattering of X-Rays by Argon. S. H. Yu. *Tsing Hua Univ., Sci. Reports,* 1. *pp.* 155–157, *May,* 1932. *In English.*—Extension and amplification of Woo's work [see preceding Abstract] with reference to argon. The total atomic absorption coefficient of argon is $\{2\cdot 20 \times 10^{0\cdot 21}\lambda^{2\cdot 8} + 0\cdot 04 \times 10^{0\cdot 21}\lambda^{0\cdot 94}\}$. A. D.

4354. Scattering of X-Rays by Gases and Crystals. Y. H. Woo. *Phys. Rev.* 41. *pp.* 21–23, *July* 1, 1932. *Tsing Hua Univ., Sci. Reports,* 1. *pp.* 177–180, *July,* 1932. *In English.*—It is shown that, in exact agreement with the wave mechanical result worked out by Wentzel and Waller and Hartree, the Raman-Compton-Jauncey formula for the scattering of X-rays by an atom deduced on the basis of classical electrodynamics may be written $I_\phi = I_e\left\{F^2 + Z - \sum_{r=1}^{z} E_r^2\right\}$, where I_ϕ is the intensity scattered in a direction ϕ with the primary beam, I_e is the scattering from a single isolated electron as calculated by Thomson, Z is the atomic number, E_r is the average amplitude of the waves scattered by the *r*th electron in the atom and F is the true atomic structure factor as given by $F = \Sigma_1^z E_r$. This shows that the coherent scattering is proportional to F^2 and that the introduction of the average atomic structure factor F′ by Jauncey is unnecessary. On the basis of this equation, theoretical formulæ for the scattering of X-rays by gases and crystals are redeveloped and the results explain all the disagreement between theories proposed by Jauncey and the writer. [See Abstract 2883 (1932).] AUTHOR.

4355. Diffuse Scattering of X-Rays from Sodium Fluoride. G. E. M. Jauncey and P. S. Williams. *Phys. Rev.* 41. *pp.* 127–135, *July* 15, 1932.—S(class) values have been obtained for the monatomic gases A and Ne by Wollan, and for the simple cubic crystals, sylvine and rock-salt, by Harvey, and Jauncey and May. F values for the average $\frac{1}{2}(K^+ + Cl^-)$ and $\frac{1}{2}(Na^+ + Cl^-)$ atoms have been obtained by James and Brindley, and James and Firth. By means of the formulæ for gases and crystals developed by Compton, and by Jauncey and Harvey, the above

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have yielded comparisons between S(class) and f' values for A and the average sylvine atoms, and for the average $\frac{1}{2}$(A + Ne) atoms and the average rock-salt atoms. The agreement on the whole has been excellent. The object of the present research was to make similar comparisons of the above results for neon with those for $\frac{1}{2}(Na^+ + F^-)$, by using Havighurst's F values for this average atom. The methods of experiment and calculation were similar to those of Jauncey and May, as modified by Harvey, except that Woo's form of the crystal formula was used to take account of the incoherent scattering. Unlike the case of argon and sylvine, it was found that the f' values for the crystal of NaF are definitely lower than those for the gas neon. This implies that for weak nuclear fields the electron distribution in an atom of a crystal is perceptibly more diffuse than that in an atom of the corresponding gas. B values were also calculated and it was found that the second hump in the B curve which is barely indicated by Wollan's values for neon is definitely present. A Fourier analysis will therefore give a U curve which shows a hump for the K electrons of NaF.
AUTHORS.

4356. Intensity of Reflection of X-Rays by Perfect Crystals. G. W. Brindley. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 271–279, *Jan.*, 1932.—The observed intensities of reflection of X-rays from perfect crystals of diamond agree with Ewald's theory only for angles of reflection less than 45°. At angles greater than this the divergence between theory and experiment becomes large. If the theory is modified to take into account the atomic form factor the theoretical predictions are of the same general form as the experimental results. F. J. W.

4357. Refraction of X-Rays by Perfect Crystals. G. W. Brindley. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 319–323, *April*, 1932.—The atomic scattering factor is introduced into Ewald's theory of X-ray reflection by perfect crystals in the manner suggested by Darwin's treatment. A better agreement is thus obtained between the refractive indices of calcite for X-rays calculated from the angular widths of reflection and those obtained experimentally by other methods. It is concluded that this points to the necessity for the factor being incorporated in Ewald's treatment of the theory of X-ray reflection. W. E. P.

4358. Reflecting and Resolving Power of Calcite for X-Rays. S. K. Allison. *Phys. Rev.* 41. *pp.* 1–20, *July* 1, 1932.—Using a precision double-crystal spectrometer, the percentage reflection of X-rays, the coefficient of reflection, and the resolving power (defined in the paper), are determined for calcite. Seven wave-lengths are employed, ranging from 0·21 Å. to 2·3 Å. Numerical predictions of the values of the above three quantities may be obtained from calculations based on Prins' modification of Darwin's theory of diffraction. The predicted and observed coefficients of reflection are in good agreement in the wave-length range between 0·5 Å. and 2·3 Å. J. T.

RADIOACTIVITY.

4359. Applications of Radioactivity to Geochemistry. O. Hahn. *Preuss. Akad. Wiss. Berlin, Ber.* 1. *pp.* 2–14, 1932.—The author discusses the determination of the age of minerals by radioactive methods assuming the constancy of radioactive processes throughout geological time. Salomon-Calvi's theory of the origin of petroleum and its accompanying large helium resources from deposits of low marine organisms capable of absorbing radium and uranium salts from the sea is also discussed. The author attributes the presence of lead in the German salt deposits to its property of forming a kind of mixed crystal with alkali chlorides. This lead has a lower atomic weight than ordinary lead and is supposed to be uranium lead deposited with alkali salts from the primeval oceans. The helium content per unit uranium content of different salt deposits of the same geological age varies too widely to ascribe the helium to the disintegration of the uranium. It may be due to RaD which would crystallise with KCl from the oceans in the same way that uranium lead is supposed to have done. J. E. R. C.

4360. Action of Radon on Unsaturated Hydrocarbons. Part II. Action on Propylene and Cyclopropane. G. B. Heisig. *Am. Chem. Soc., J.* 54. *pp.* 2328–2332, *June,* 1932.—The values of the ratio $-M/N$ (1) determined from the action of radon [see Abstract 891 (1932)], and (2) deduced from heat of formation [see Abstract 3040 (1932)] are compared. By method (1) the average percentage of the volume of $H_2 + CH_4$ formed on the diminution in volume of the hydrocarbon, and $-M/N$ for propylene are respectively 14·4 and 4·9; for cyclopropane, 20·5 and 3·3; calculated additively, $-M/N$ is 3·4 and 3·5. By method (2) the ratio for propylene is 4·8. The products of the action of radon on both hydrocarbons are light mobile oils. The values of $-M/N$ increase with unsaturation. C. A. S.

4361. Complex Nature of Polonium Ions. M. Haïssinsky. *Comptes Rendus,* 195. *pp.* 131–133, *July* 11, 1932.—The relative amounts of polonium carried to kathode and anode during electrolysis of solutions containing polonium with sodium hydroxide, or nitric, sulphuric, chromic, phosphoric, or acetic acid with a salt of the same acid, or of tartaric or oxalic acid alone, show that in solution with sodium hydroxide $\nless 0{\cdot}15\,N$ the polonium is probably present as polonite, but in the acid solutions as a complex, *e.g.*, $[Po(NO_3)_6]''$, $[Po(C_2O_4)_3]'''$. [See Abstract 3790 (1932).] C. A. S.

4362. New Determination of the Disintegration Constant of Uranium by the Method of Counting α-Particles. A. F. Kovarik and N. I. Adams, Jr. *Phys. Rev.* 40. *pp.* 718–726, *June* 1, 1932.—α-Particles emitted by a known amount of pure U_3O_8 in the form of thin films were restricted in their passage into an ionisation vessel by cylindrical channels of a grid placed over the material. The method of counting α-particles alone was that of Greinacher [see Abstract 3145 (1927)]. All α-particles entering the ionisation chamber automatically registered on a mechanical counter, for which an elaborate electrical and mechanical arrangement of apparatus was used. Over 100,000 counts were made from two specimens differing in surface density in the ratio of nearly 5 to 1. The λ_{U1} obtained is $1\cdot53_2(10)^{-10}$ yr.$^{-1}$ or $T = 4\cdot52_4(10)^9$ yr., a value consistent with Gleditsch's $\lambda_{Ra} = 4\cdot11(10)^{-4}$ yr.$^{-1}$, Boltwood's radium to uranium ratio of $7\cdot40(10)^{-7}$ and branching ratio between 0·96 and 0·97. AUTHORS.

4363. Wave-Statistical Theory of Radioactive Disintegration. K. C. Kar and A. Ganguli. *Indian Phys. Math. J.* 3. *pp.* 81–88, *June*, 1932.—A theory of radioactive disintegration is developed by the application of Kar's hypothesis of a viscous phase space [see Abstract 1868 (1932)]. J. J. S.

4364. Production of High-Velocity Positive Ions. J. D. Cockcroft and E. T. S. Walton. *Roy. Soc., Proc.* 136. *pp.* 619–630, *June* 1, 1932.—The authors describe a method of producing protons with an energy of about 800,000 electron volts, the technique being a development of the method used previously [see Abstract 1363 (1931). By a system of diodes and condensers a given a.c. voltage may be stepped up by a factor of $2n$ and the resultant d.c. voltage may be arranged to have a very small fluctuation. For larger powers the authors suggest a method using triodes in addition to the diodes, but difficulties due to the high voltages dealt with are predicted. With the arrangements described, proton currents of the order of 10 μA have been obtained by accelerating the protons produced in a small discharge tube and then passing them out of the high-voltage tube through a thin mica window. A detailed account of the vacuum technique employed and a preliminary account of an investigation of the range of the protons is also given. J. E. R. C.

4365. Experiments with High-Velocity Positive Ions. Part II. Disintegration of Elements by High-Velocity Protons. J. D. Cockcroft and E. T. S. Walton. *Roy. Soc., Proc.* 137. *pp.* 229–242, *July* 1, 1932.—Experiments are described which show that, under the bombardment of protons having energies above 150,000 volts, α-particles are emitted from many elements. The interpretation of the results of the experiments with Li is that Li^7 captures a proton and that the resulting nucleus of mass 8 breaks up into two α-particles which are projected in pairs in opposite directions. The results obtained from the bombardment of other elements are described. [For Part I see Abstract 1363 (1931).] W. E. P.

4366. Artificial Disintegration of Aluminium and Nitrogen. E. Steudel. *Zeits. f. Physik*, 77. 3–4. *pp.* 139–156, *July* 26, 1932.—The author describes an apparatus which he has used for investigating the artificial disintegration of Al and N. The protons produced by α-particles from polonium are detected by a Geiger point counter and their absorption curves determined. Three groups of ranges 33, 49 and 63 cm. are found, together with a possible group of range 26 cm. Investigation in the region 8·4 cm. to 20 cm. does not show protons with distributed velocities. The disintegration of N is also examined and reveals only one group of range 17·2 cm. After experiments in which the range of the incident α-particles is varied, the author concludes that there is no evidence for the phenomenon of resonance ranges which have been reported by other investigators. Instead, a continuous variation of the intensity of the disintegration protons with variation of the α-particle energy is observed. J. E. R. C.

4367. Potential Barrier of Nitrogen Nucleus. E. C. Pollard. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 324–330, *April*, 1932.—The paper describes an experiment from the results of which it is concluded that the disintegration of nitrogen is produced by the entry of an α-particle over the top of the potential barrier and not by resonance at a " virtual " level of energy. W. E. P.

4368. Transparency of a Coulomb Potential Barrier to α-Particles. W. Alexandrow. *Zeits. f. Physik*, 76. 5–6. *pp.* 415–419, *June* 7, 1932.—The author investigates the potential barrier due to a pure Coulomb field and gives a rigorous solution of the equations. The Gamow formula and the Geiger–Nuttall relation are deduced and an approximate formula for the breadth of the barrier is obtained by Debye's method. J. E. R. C.

4369. Mesothorium II. G. Guében. *Ann. Soc. Sci. de Bruxelles*, 52. *pp.* 60–66, *June* 8, 1932.—Reference is made to Cranston's discovery of the emission of α-rays from a fresh preparation of mesothorium II. The author repeated the experiment, obtaining a fresh preparation of MsThII by using Hevesy's method, details of which are given. Careful measurements of ionisation due to α-rays were made with a Piccard electrometer, particular care being paid to the earlier stages of the emission. The results are shown graphically. The calculated and observed results agree remarkably after 65 hours and up to at least 290 hours. Calculations of the percentages of various elements give more RaTh and less ThC and ThC′ than Cranston found, which explains the apparent error. The difference between the calculated and experimentally observed curves is due to the α-rays emitted by MsThII. R. S. R.

4370. Range of α-Particles, Nuclear Charge and Proton Number. S. Meyer. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 1–2. *pp.* 71–78, 1932.—By plotting $\log R_0$ (R_0 = range of α-particle emitted), against the proton number of the radioactive substance a series of parallel straight lines is obtained which may be represented by the equation $R_0 = \log D + 0{\cdot}60 - 0{\cdot}043(P - 223)$, where P = the proton number and D is a function of the nuclear charge which varies qualitatively with the third root of the reciprocal atomic volume and with an equal period. J. E. R. C.

4371. Anomalous Scattering of α-Particles by Hydrogen and Helium. H. M. Taylor. *Roy. Soc., Proc.* 136. *pp.* 605–618, *June* 1, 1932.—A development of an earlier paper [see Abstract 1653 (1932]). The author applies wave-mechanical methods to the scattering of α-particles by H and He and obtains good agreement with experiment. Small angle scattering can be explained by the same field as is postulated for large angle scattering. In particular, it is shown that the scattering by H does not need a plate-like form for the α-particle to explain the distribution. The author discusses the dependence of the results upon the form of the field assumed and shows that provided that it is assumed that the potential energy is Coulombian for distances greater than about 5×10^{-13} cm., then whatever the form of the potential for smaller distances, the ratio of the scattering to that to be expected for a purely Coulombian field is given by a formula which contains only one parameter which depends upon the velocity of the incident α-particle and on the field assumed, but is independent of the angle of scattering. The author can thus deduce a value for this parameter from one set of experimental values and can then deduce the scattering at other angles for the same value of the velocity. These results are independent of the form of the field for small distances. Good agreement is obtained. J. E. R. C.

4372. Fine Structure of the Magnetic Spectrum of the α-Rays of Radium. S. Rosenblum. *Comptes Rendus,* 195. *pp.* 317–319, *July* 25, 1932.—An account is given of the study of the Ra α-radiation with the aid of the large electromagnet of the Academy of Sciences. Various photographs were taken under different conditions. The results found for the velocity of the α-rays from Ra now directly determined for the first time are as follows: $V\alpha Ra = 1 \cdot 517 \times 10^9$ cm./sec., $V\alpha Ra = 1 \cdot 488 \times 10^9$ cm./sec., $V\alpha Ra = 1 \cdot 623 \times 10^9$ cm./sec. The velocities are calculated on taking for RaA (which exists on several photographic plates), $V\alpha RaA = 1 \cdot 698 \times 10^9$ cm./sec. J. J. S.

4373. Existence of a Neutron. J. Chadwick. *Roy. Soc., Proc.* 136. *pp.* 692–708, *June* 1, 1932.—The author discusses the hypothesis due to Curie-Joliot and Joliot, that the penetrating radiation emitted from Be when this is bombarded with α-particles is γ-radiation of high energy and describes experiments designed to test this. It is shown that the production of γ-radiation of such high energy is difficult to explain using reasonable values for the mass defects. The author has investigated the radiation with a valve counter and shows that the radiation can project protons from paraffin wax. The effect of the radiation upon other elements is investigated and it is shown that it can project nitrogen nuclei forwards. Calculation shows that if the nitrogen particle acquires its momentum by a Compton process the radiation must have an energy of about 90×10^6 electron volts, which is much higher than that deduced from the experiments upon paraffin wax. It is shown that the assumption that the radiation consists of neutrons of mass approximately 1 leads to consistent values for its energy. The process of production of these neutrons is discussed. It is also shown that B^{11} probably emits neutrons when bombarded with α-particles and calculations based upon this hypothesis give the mass of the neutron as lying between 1·005 and 1·008. The scattering of the neutrons by nuclear fields is discussed and some values for collision areas of various elements are calculated. Assuming that a neutron consists of an electron and a proton in close binding, various anomalies—such as the absence of electron spin in the nucleus—can be easily explained. It is pointed out that Be probably emits γ-radiation also and that this should lead to the production of at least two neutron groups. [See two following Abstracts.] J. E. R. C.

4374. Collisions of Neutrons with Nitrogen Nuclei. N. Feather. *Roy. Soc., Proc.* 136. *pp.* 709–727, *June* 1, 1932.—The author has examined the tracks produced in a nitrogen-filled expansion chamber when exposed to neutrons from beryllium. The photographs indicate that a new type of disintegration is possible in which the collision causes the emission of an α-particle. This process may be accompanied either by capture or non-capture of the neutron. Twelve cases of fairly certain neutron capture and rather more cases of non-capture were recognised. It is pointed out that the reaction $B^{11} + He^4 = N^{14} + n$ is apparently reversible. [See preceding and following Abstracts.] J. E. R. C.

4375. Interaction of Neutrons with Electrons. P. I. Dee. *Roy. Soc., Proc.* 136. *pp.* 727–734, *June* 1, 1932.—If the beryllium radiation consists of neutrons the range of recoil electrons should be about 3 mm. If, on the other hand, it is electromagnetic, the range should be several metres and the author describes experiments with an expansion chamber designed to investigate this point. No certain evidence of a recoil electron was obtained. From a careful examination of the tracks the author deduces that a neutron produces about one pair of ions for 3 m. of air path. The author has also observed a case of disintegration of a nitrogen nucleus by a neutron. [See two preceding Abstracts.] J. E. R. C.

4376. Radiations Excited in Light Atoms by α-Particles. Irène Curie, F. Joliot and P. Savel. *Comptes Rendus,* 194. *pp.* 2208–2211, *June* 20, 1932.—The neutrons projected from beryllium by α-particles, in the same direction as those particles, eject from paraffin a larger group of H-particles of range 28 cm. in air, and a smaller group of maximum range about 70 cm. The neutrons projected backwards (at 120–180°) eject H-particles of range 23 cm. The velocities of the larger forward and of the backward groups (both of which may, however, be heterogeneous) are respectively $3\cdot84$ and $2\cdot94 \times 10^9$ cm./sec. It is suggested that they are the result of the reactions $Be^9 + \alpha = C^{12} + n\nearrow$, and $Be^9 + \alpha = C^{12} + n\nearrow + \gamma$ respectively. The atomic weight of Be^9 deduced therefrom is $9\cdot006$. The neutrons projected backwards are diffused to a greater extent by lead than by copper. The radiation from lithium produced by α-particles from polonium is similarly dis-symmetric; the ratios of the ionisation produced by the forward radiation to that produced by γ-rays of polonium in hydrogen, nitrogen and argon are respectively $0\cdot55$, $0\cdot31$, and $0\cdot25$; it is equally absorbed by 1g./cm.^{2} of paraffin or by 4 g./cm.^{2} of lead. This radiation also probably consists of neutrons, and is perhaps due to the reactions $Li^6 + \alpha +$ electron $= Be^9 + n\nearrow$, or $Li^7 + \alpha = B^{10} + n\nearrow$. [See also Abstracts 3317 and 3797 (1932).] C. A. S.

4377. γ-Radiation from Boron and Beryllium. H. Becker and W. Bothe. *Zeits. f. Physik,* 76. 7–8. *pp.* 421–438, *June* 20, 1932.—Using a point counter the authors have determined the absorption coefficients of the γ-radiation released from Be by bombardment with α-particles from polonium and obtain $0\cdot17 \pm 0\cdot02$ in iron and $0\cdot23 \pm 0\cdot2$ in lead. These measurements do not give a trustworthy value for the energy of the radiation, however, and another method, in which the absorption coefficients of the recoil electrons produced by the radiation are determined, is considered to give more reliable results. For this measurement, two tube counters are employed and the well-known coincidence method adopted, the aluminium absorber being inserted between the two counters. The apparatus was calibrated with ThC″ radiation and the energy of the Be radiation is deduced as being about 5×10^6 electron volts. This energy does not vary much with the energy of the α-particles. The radiation is not very asymmetric. Plotting the excitation probability against the α-particle energy, a remarkable minimum is disclosed. The radiation from boron is also investigated and its energy is given as 3×10^6 electron volts and the properties of the radiation are very similar to those of the Be radiation. It is suggested that this, as well as that of the Be, consists of neutrons. J. E. R. C.

4378. Emission of Slow Neutrons in the Radiation Excited from Beryllium. P. Auger. *Comptes Rendus,* 195. *pp.* 234–236, *July* 18, 1932.—The radiation emitted from Be when bombarded with α-particles is investigated with an expansion chamber containing H_2. Proton tracks are produced by the impact of neutrons, and their energy is deduced by bending them in a magnetic field. A large number, which are at a small angle to the neutron's direction, have energies lying between 30 and 500 ekV and are explained as due to slow neutrons. In another series of experiments the author has shown that surrounding the expansion chamber with a heavy screen of copper increases the number of tracks observed, and he explains this as a result of scattering by the heavy copper nuclei. As a possible explanation of the slow neutrons the author suggests the simultaneous emission of hard γ-radiation from the Be; alternatively, there may be some process by which a fast neutron can produce a slow proton in a nearly head-on collision. J. E. R. C.

4379. Demihelions. F. Perrin. *Comptes Rendus*, 194. *pp.* 2211–2213, *June* 20, 1932.—It is suggested that the single anomalous track observed by Blackett and Lees [see Abstract 3791 (1932)] is the result of expulsion of a demihelion [see Abstract 3315 (1932)], of which the atomic weight would be 2·0115 ± 0·0005. C. A. S.

4380. Radioactive Transformations. L. Wertenstein. *Comptes Rendus*, 194. *pp.* 2305–2307, *June* 27, 1932.—The author discusses the possibility of atomic nuclei being formed from α-particles, demi-helions and neutrons from the point of view of radioactive transformations and artificial disintegration. J. E. R. C.

4381. Constitution and Stability of Atomic Nuclei. A. Schidlof. *Arch. des Sciences*, 14. *pp.* 125–148, *May–June*, 1932.—The author considers that the principal constituents of atomic nuclei are α-particles and α_1-particles (the latter being an exothermic combination of an α-particle and an electron and also termed a pseudo proton). Present knowledge of isotopes and isobares is discussed on the basis of the above hypothesis and the stability of nuclei is investigated with the result that the mass defect of the α_1-particle is estimated with fair accuracy. J. E. R. C.

4382. Structure of Atomic Nuclei. (Lord) Rutherford. *Roy. Soc., Proc.* 136. *pp.* 735–762, *June* 1, 1932.—The most important lines of experimental attack on the problem of the structure of atomic nuclei are described and discussed. The section headings are: (1) Optical methods; (2) application of wave mechanics: it is suggested that uncharged units of mass 2 as well as the neutron of mass 1 may be secondary units in the structure of nuclei; (3) origin of γ-rays; it appears clear that the nuclear γ-rays are due to the transition of an α-particle between energy-levels in an excited nucleus: reference is made to the remarkable difference between the emission of an α-particle and a β-particle in disturbing a nucleus; (4) excitation of nuclei by γ-rays; (5) scattering of α-particles; (6) general remarks; and (7) addendum on the disintegration of lithium nuclei. The following authors contributed to the *Discussion* which followed the above address: **J. Chadwick** on bombardments of atoms by means of α-particles; **C. D. Ellis** on the spectra of γ-rays (the principle of conservation of energy appears to apply to that part of the nucleus which is associated with the emission of α-particles and γ-rays); **R. H. Fowler** on the value of the nuclear spin as obtained from (*a*) the alternating intensities in the band spectra of diatomic molecules in which the two atoms are identical, and (*b*) from the details of the hyperfine structure of atomic spectra; **J. C. McLennan** on spin quantum numbers and certain anomalies connected with them; **F. A. Lindemann** on difficulties involved in nuclear models; **N. F. Mott** on the anomalous scattering of fast particles in hydrogen and helium. It is mentioned in what circumstances the number of particles scattered depends on the statistics obeyed by the particle. H. L. B.

4383. Structure of Atomic Nuclei. Part I. W. Heisenberg. *Zeits. f. Physik,* 77. 1–2. *pp.* 1–11, *July* 19, 1932.—The author discusses the possibility of nuclei being constructed from protons and neutrons only. Ascribing a spin of $h/4\pi$ to the neutron, then if it consists of a proton and an electron, the electron must have zero spin and follow the Bose statistics. This is considered to be improbable, and the author would prefer to look upon the neutron as a fundamental unit. The forces between a neutron and a proton and between two neutrons are considered and their equations deduced. The case of radioactivity is discussed, particularly as regards β-ray disintegration. The variation of the ratio of the number of neutrons to the number of protons is investigated and a chart showing the limits in which this ratio must lie is drawn. When this ratio becomes less than a certain critical value the nucleus will disrupt and restore the ratio to a stable value, and the author discusses the conditions which determine the manner of the disruption. J. E. R. C.

4384. γ-Radiation and its Relation to Nuclear Structure. P. G. Kruger. *Phys. Rev.* 40. *pp.* 727–730, *June* 1, 1932.—A formula has been obtained which enables the calculation of the wave-lengths of γ-radiation from the nucleus. Such calculations have been made for fourteen different radioactive elements and the observed and calculated λ's compared. The largest discrepancy is about 12 %. γ-Ray series which check the observed γ-ray wave-lengths to less than 5 % have been calculated for AcX and RaB. The intensities of the lines in these series are peculiar. With the same formula the shortest possible radiation from U has been calculated and found to be of the order of magnitude of cosmic radiation. AUTHOR.

4385. Nature of the Interaction between γ-Radiation and the Atomic Nucleus. L. H. Gray and G. T. P. Tarrant. *Roy. Soc., Proc.* 136. *pp.* 662–691, *June* 1, 1932.—A number of independent investigations have shown that γ-radiation of 2 to 3 million volts quantum energy is much more strongly absorbed than would be expected in elements of high atomic number. The additional absorption has been attributed provisionally to interaction with the nucleus. This conclusion receives further support from the experiments described in this paper, which show that in the case of the hard γ-rays of ThC″ and RaC the absorption is associated with the emission of a secondary γ-radiation quite unlike the radiation scattered by the electronic system of the outer atom, in that the wave-length of this radiation is neither the same as that of the primary radiation, nor varies with angle in accordance with the Compton equations. Moreover, the quantum energy of the secondary radiation appears to be independent of that of the primary radiation, provided this exceeds a certain threshold value, which by two independent methods has been found to lie between 1·5 and 2·0 million volts These results suggest that the absorption process consists in the excitation of the nucleus, which subsequently emits " characteristic radiations." The absorption curves of the characteristic radiations of lead, tin, iron and oxygen have been found to be very similar. A unique determination of wave-length is not possible by absorption methods, but the simplest interpretation of the curve is that all four elements emit the same two radiations (having quantum energies of 0·5 and 1·0 million volts) but in different proportions, leading to the view that the radiations are characteristic of some unit of nuclear structure present in all nuclei. **Authors.**

4386. Close Collisions of Fast β-Particles with Electrons. F. C. Champion. *Roy. Soc., Proc.* 136. *pp.* 630–637, *June* 1, 1932.—Relativistic mechanics predicts that when a fast electron collides with another which is initially at rest, the angle between the two paths after collision is no longer 90° and becomes smaller as the velocity of the moving electron approaches that of light. The author describes experiments with an automatic Wilson chamber designed to investigate this point. Fast electrons were obtained from RaE (up to $0\cdot94\,c$). The velocities were measured by bending the particles in a magnetic field of 250 gauss. Experiments were made with N and O, and about 50 close collisions were observed. The measured angles agree very well with those calculated. The author discusses possible errors, in particular that due to an emission of radiation which might possibly occur at the instant of collision. In this connection, the author shows a photograph of a collision in which the tracks are not coplanar. J. E. R. C.

4387. Magnetic Spectrum of β-Rays of ThoriumC + C′ + C″. S. V. Sze. *Comptes Rendus*, 194. *pp.* 2206–2208, *June* 20, 1932.—Using the same methods as before [see Abstracts 2895 and 2899 (1932)] the intensities, Hρ, and energies of 56 (18 being new), β-rays of this spectrum have been measured, with Hρ 1398 as standard. Of these 12 are considered to be due to the conversion of γ-rays in the atom of thoriumC″ [see Abstract 113 (1926)]. C. A. S.

4388. Absorption Measurements and the Continuous Spectrum of β-Rays. J. A. Chalmers. *Cambridge Phil. Soc., Proc.* 28. *pp.* 319–327, *July* 30, 1932.—Many experiments have shown that the absorption curve for natural heterogeneous β-rays is exponential except for large thicknesses of absorber, for which it falls below the exponential curve and then gives a definite kink. Adopting the expression $(\mathrm{A}a^2xe^{-ax})/\mathrm{B}$ (where A, B and a are constants), as representing with sufficient accuracy the form of the continuous spectrum of β-ray bodies, for which the maximum should occur at $x = 1/a$, the author shows that the kink should occur at a range less than the extrapolated range. A relation between the range at which the kink occurs and the range at which the maximum occurs is deduced and agrees very well with the experimental results. J. E. R. C.

4389. Energy Problems in the Continuous Spectra of β-Rays. J. A. Chalmers. *Cambridge Phil. Soc., Proc.* 28. *pp.* 328–337, *July* 30, 1932.—The author discusses the problem of the continuous energy distribution associated with the disintegration β-rays of various radioactive bodies. This characteristic of a β-ray disintegration is contrasted with the homogeneity of disintegration α-particles, and possible methods of explaining the difference are discussed. If the disintegrating nuclei have the same energy initially they cannot finally have the same energy. The author suggests an experiment whereby deflection of the recoiling nuclei in a magnetic field would enable the nuclei of different energies to be separated and their decay constants, etc., investigated. A further experiment using UX_1 (which emits a β-ray, forming UX_2, which also emits a β-ray), in which the emitted β-rays due to both disintegrations might be detected is also described. It is suggested that these experiments would decide whether the emission energy of the product of a decay depends upon the emission energy of the parent substance. J. E. R. C.

4390. Compton Effect of Very Hard γ-Rays of ThoriumC″. D. Skobelzyn. *Comptes Rendus,* 194. *pp.* 1914–1917, *May* 30, 1932.—470 observations with γ-rays of thoriumC″ filtered through 30 mm. of lead give an angular distribution curve showing fair agreement with that deduced from the Klein–Nishina formula, but the same excessive maximum for deviations of 8–10° inexplicable by the theory as it stands. [See Abstracts 888 (1931) and 3323 (1932).] C. A. S.

4391. δ-Rays and Range/Velocity Relations for Slow Electrons. T. Alper. *Zeits. f. Physik,* 76. 3–4. *pp.* 172–189, *May* 31, 1932.—The author describes the use of a low-pressure Wilson chamber with large expansion speed. Stereoscopic photographs were taken and tracks were measured with a stereo-micrometer. The ionisation produced by α-particles of a series of five ranges was examined with the chamber, and several specimen photographs are reproduced in the paper. No δ-rays are visible in the last 1–2 mm. of path. The author deduces that for a single α-particle the maximum ionisation occurs between 1·5 mm. and 2·5 mm. from the end of its path. The author shows the relation between the number of δ-rays and their range. A δ-ray of maximum range will have approximately twice the velocity of the α-particle producing it. Hence the author is able to show a range/velocity curve for the δ-rays. A plot is also shown of the relation between the number of δ-rays per mm. and their energy, the energy being calculated from their velocity, which was, in turn, determined from the range/velocity curve described above. The range/velocity results are finally represented by the formula $R = aV^n$, and a series of values of n are tabulated in which n varies from 2·0 for low velocities to 3·7 for high velocities. J. E. R. C.

4392. Direct-Reading γ-Ray Electroscope. L. G. Grimmett. *Phys. Soc., Proc.* 44. *pp.* 445–450; *Disc.,* 450, *July* 1, 1932.—A dead-beat direct-reading γ-ray electroscope having a linear scale graduated in mg. of radium is described. It is a combination of a special ionisation chamber, Lindemann electrometer and high resistance, and allows the estimation, in less than three seconds, of the activity of small γ-ray sources of the order 1 mg. Ra with an accuracy of 0·5 % on a full scale deflection. AUTHOR.

4393. γ-Ray Ionisation Chamber. G. C. Laurence. *Canad. J. of Research,* 7. *pp.* 103–105, *July,* 1932.—A description is given of a γ-ray ionisation chamber with its accessory electrometer box, suitable for precision measurements of radioactive preparations, and for the measurement of the absorption coefficient and specific ionising powers in air of γ rays. AUTHOR.

4394. Ionisation of Air by γ-Rays as a Function of Pressure and Collecting Field. I. S. Bowen. *Phys. Rev.* 41. *pp.* 24–31, *July* 1, 1932.—The ionisation of air by γ-rays was studied for pressures from 1 to 93 atmospheres and for collecting fields from 1·55 to 1009 volts per cm. Increases in ionisation current of over 40 % were observed when the potential gradient was varied over this range, thus indicating that the lack of proportionality of ionisation current with pressure obtained by previous observers was principally due to lack of saturation. AUTHOR.

HEAT.

4395. Theory of Heat Conduction and Convection from a Low Hot Vertical Plate. W. S. Kimball and W. J. King. *Phil. Mag.* 13. *pp.* 888–906, *May,* 1932.—A mathematical theory is given of heat conduction and convection from a low hot vertical plate in air. Heat radiation is not considered. A detailed analysis is made which is based on the actual gas temperature and velocities inside an actual film having as its outer boundary an isothermal surface at temperature half-way between the hot surface and the ambient air, and which approaches the equivalent Langmuir film of uniform thickness asymptotically as the height increases. The theory confirms various laws such as: the total heat convected away varies as the (5/4)th power of the temperature difference; the maximum velocity is independent of pressure and is proportional to the square root of the temperature difference; heat transfer coefficients are proportional to the square root of the pressure; the film thickness varies inversely as the fourth root of the temperature difference. H. L. B.

4396. Principle of Similitude and the Heat Flow through a Granulated Material. O. A. Saunders. *Phil. Mag.* 13. *pp.* 1186–1188, *June,* 1932.—Discusses the application of the principle of similitude to heat flow through a heterogeneous body with given surface temperatures, and extends the results obtained by Awbery [see Abstract 1662 (1932)]. The principle is also applied to the case of a system of perfect conductors when heat is transferred from one surface to another at a rate proportional to the difference in temperature between the surfaces, independently of their distance apart (Newton's law). In the first case, the overall conductivity of a granulated material would be independent of grain size, and in the second case it would vary directly with size. In practice the transfer will lie between these two extremes. J. H. A.

4397. Flow of Heat through Plates. R. Ruedy. *Canad. J. of Research,* 6. *pp.* 577–583, *June,* 1932.—The speed is calculated with which the steady flow of heat is established in a slab of uniform temperature after one boundary plane has been suddenly brought to a higher temperature, or when the temperature of both planes is changed. In both cases the flow of heat may be expressed by means of simple Θ functions, and the law of approach to the steady state may be used for determining the diffusivity of the material. When one boundary plane undergoes sinusoidal variations in temperature while the other is maintained at a constant level, a finite thickness is found for which, in the steady state, the heat flowing in or out during one half-cycle reaches its highest value. AUTHOR.

4398. Geometry of the Heat Equation. Part I. E. Kasner. *Nat. Acad. Sci., Proc.* 18. *pp.* 475–480, *June,* 1932.—A family of heat curves is defined to be the double infinitude of isothermals (for all instants of time) in a problem of two-dimensional heat flow. It is shown that neither all the straight lines in a plane nor any double infinitude of circles can form such a family. If the family consists of straight lines or circles then the curves do not change with time. The lines must all be parallel or concurrent, and the circles are subject to geometrical restrictions. The physical conditions necessary for these cases to occur are investigated. J. H. A.

4399. Heat Conduction, Wiedemann-Franz-Lorenz Number and Thermoelectric Force of Single Mercury Crystals. H. Reddemann. *Ann. d. Physik,* 14. 2. *pp.* 139-163, *July* 12, 1932.—The paper describes measurements of the heat conductivity of single mercury crystals in order to calculate the Wiedemann-Franz-Lorenz number for different directions in the crystal. O. Sckell [see Abstract 940 (1931)] has measured the specific electrical resistance in different directions in the crystal. The single crystal is prepared in a glass tube (sketch given) which is placed inside an iron vessel, which can be evacuated. The vessel is placed in a mixture of solid CO_2 and ether. Lees' method of constant heat flow is used to determine the heat conductivity. The source of heat is a small coil of wire carrying a current and placed on top of the crystal, the temperatures of the crystal at the desired sections being determined by thermal junctions attached to platinum wires fused into the glass walls of the containing vessel. The expressions necessary for the calculation of the conductivity λ in any direction with reference to the axis of the crystal are developed. The results of the experiments are given in tables, the values of λ at $-77°$ are found to be $0 \cdot 341$ parallel, and $0 \cdot 264$ perpendicular to the axis. At $-187°$ the corresponding values are $0 \cdot 399$ and $0 \cdot 290$ respectively. The Wiedemann-Franz-Lorenz law is found to hold approximately down to the temperature of liquid air. By suitably connecting the thermojunctions the thermal e.m.f. between constantan and manganin and the two principal directions of the mercury crystal are measured, and hence the thermal e.m.f. of Hg parallel against Hg perpendicular to the axis is calculated. T. B.

4400. Thermal and Electrical Conductivities of Zinc and Cadmium Crystals. E. Goens and E. Grüneisen. *Ann. d. Physik,* 14. 2. *pp.* 164-180, *July* 12, 1932.—This paper completes the work of which a preliminary notice appeared in 1926 on the measurement of heat conductivity of crystals of Zn and Cd. During the interval papers have appeared by Bridgeman, Kaye and Roberts, and Bidwell and Lewis. The results obtained show considerable discrepancies, and the authors conclude that decisive measurements are needed on these quantities. The purity and freedom from strain of the rods of metal are first considered. This is done by measuring the electrical resistances parallel and perpendicular to the hexagonal axis. The apparatus used for the measurement of the heat conductivity is that previously described [see Abstract 3196 (1927)]. At room-temperatures the radiation loss is found to amount to 8-15 %, and it is necessary, therefore, carefully to measure its amount. The method of doing this is described. The variations in the value of the thermal conductivity are found to be due to its change with temperature. (A graph is given showing this.) Values of the observed quantities are tabulated and also the calculated values of the Wiedemann-Franz-Lorenz number $L = Q/Tw$. The values of the latter decrease as the temperature falls. At room-temperatures in both principal directions the values agree with theory. At lower temperatures L decreases faster in that direction, which corresponds to a higher characteristic temperature. This for both metals is perpendicular to the axis. The *Korngrösseneffekt, i.e.*, the difference in properties between a single crystal and a polycrystalline rod, does not appear to exist with either Cd or Zn. T. B.

4401. Heat Transfer by Free Convection. R. Hermann. *Phys. Zeits.* 33. *pp.* 425–434, *June* 1, 1932.—Discusses anew the problem of convection and its numerical treatment by expressing one dimensionless variable as a function of other dimensionless variables. Special attention is given to the simplifications which occur when the temperature differences are small. J. H. A.

4402. Realisation of a Black Body at the Temperature of Boiling Metals. T. N. Panay. *Comptes Rendus,* 194. *pp.* 2198–2200, *June* 20, 1932.—A description is given of a black body maintained at the temperature of boiling zinc (1180° K.). H. H. Ho.

4403. Radiometer Forces in Gases at Low Pressure. G. Spiwak. *Zeits. f. Physik,* 77. 1–2. *pp.* 123–125, *July* 19, 1932.—The force due to the movements of the gas molecules acting on a square plate of finite dimensions which is maintained at a lower temperature than an adjacent parallel plate is calculated; the variation of the force with change of distance between the plates gives directly the " end effect " of the Knudsen radiometric manometer. At relatively great distances the force is inversely proportional to the distance. The equation obtained yields values in close agreement with published experimental data. H. F. G.

4404. Optical Method for Measuring Temperature Distribution and Convective Heat Transfer. R. B. Kennard. *Bureau of Standards, J. of Research,* 8. *pp.* 787–805, *June,* 1932.—In order to avoid the errors inherent in material thermometers, a method has been devised whereby the temperatures in the region of heated air near a hot surface may be determined from the displacement of the fringes in an interferometer. Photographs were taken of the interference fringes near a hot vertical plate and near horizontal heated cylinders. The temperature distribution and the convective heat transfer were determined from measurements made on enlargements of these photographs. It is shown that the temperature distribution does not correspond to that called for by the film theory. AUTHOR.

4405. Precision Thermojunction Needle. R. W. Brown. *Journ. Sci. Instruments,* 9. *pp.* 198–200, *June,* 1932.—The instrument has been designed to give rapid and accurate readings of the temperature in pneumatic tyres, and it is suggested that it may be useful for measuring the temperature in plastic and other materials. The actual thermojunction is carried at the end of an ordinary hypodermic needle, so that it may be pushed into the substance of which the temperature is required without damaging the thermocouple or altering its calibration owing to strain. Heat leakage along the leads is eliminated by heating the upper portion of the needle with an accessory heating coil, until a thermocouple located in the upper portion indicates the same temperature as the couple in the substance being measured. J. H. A.

4406. Absolute Measurement of Radiant Energy. P. A. Leighton and W. G. Leighton. *J. Phys. Chem.* 36. *pp.* 1882–1907, *July,* 1932.—The authors have collected in one paper the results of many studies with different types of thermopiles in the measurement of radiant energy. The measurement of the absolute intensity of visible and ultra-violet light by means of a thermopile-galvanometer system has been discussed with particular reference to the conditions existing at the exit slit of a monochromator. Various sources of error have been investigated including those inherent in the galvanometer and thermopile as well as certain sources of error created by employing a thermopile for the measurement of diverging light differing in wave-length from that of the light from standard carbon filament lamps. Several important precautions have been emphasised and certain sources of error have been shown negligible. The advantages of linear thermopiles over certain surface piles of commercial make have been demonstrated. The observation of galvanometer deflections, under the conditions of "swinging equilibrium," successfully used by the authors and others has been described. Details are included for integrating the total intensity of a light beam which presents a cross-section greater than the active receiving area of the thermopile. Three methods of extrapolating the thermopile-galvanometer sensitivity curve are outlined, none of these requiring the assumption of the inverse square law. A simple equation has been derived and verified experimentally which extends the calibration curve to include various resistance patterns useful at high intensities. R. S. R.

4407. Automatic Registration of Small Temperature Variations Over a Wide Range. H. Rieche. *Zeits. f. techn. Physik,* **13.** 8. *pp.* 374–377, 1932.—The apparatus uses two platinum resistance thermometers arranged differentially in a specially designed a.c. bridge, the out-of-balance current being amplified and used to effect registration on a suitable instrument. J. H. A.

4408. Temperature Regulator. H. Moser. *Zeits. f. techn. Physik,* 13. 8. *pp.* 383–385, 1932. *From the Reichsanstalt.*—A temperature regulator is described in which a resistance thermometer is inserted in a Wheatstone bridge so that when the bridge is out of balance the spot of light from a mirror galvanometer actuates a selenium cell, and so controls the heating current. The special feature of the arrangement is that the complication of an apparatus to adjust the heating current continuously is avoided without the disadvantage of the method of switching entirely on or off. This result is achieved by applying the energy in the form of current pulses at intervals of about 1·5 sec. J. H. A.

4409. Temperature Regulator for Electrical Resistance Furnaces. R. F. Proctor and R. W. Douglas. *Journ. Sci. Instruments,* 9. *pp.* 192–195, *June,* 1932.—The regulator makes use of the fact that the resistance of the furnace windings varies with temperature. Two filaments connected respectively across a coil in series with the furnace, and across the furnace itself, are located in the two limbs of a differential air thermometer, so that a change in the resistance of the furnace causes a movement of the mercury in the air thermometer. This movement is used to operate a relay which removes or adds resistance in the furnace circuit. The apparatus as constructed maintains such a degree of constancy in the temperature as corresponds to variations not exceeding 0·5 % in its resistance. J. H. A.

4410. X-Ray Studies of Thermal Expansion of Bismuth Single Crystals. A. Goetz and R. C. Hergenrother. *Phys. Rev.* 40. *pp.* 643–661, *June* 1, 1932.—The temperature shift of Bragg reflections is measured between liquid-air temperature and the melting point of the bismuth. The computed values of the coefficient α of thermal expansion (parallel to the axis of the crystal) differ from macroscopic measurements by various

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authors to a greater extent than the combined errors of the experiments. Gruneisen's relation α/C_p = constant is found to be fulfilled for the X-ray value of α (which refers directly to the lattice) but not for the macroscopic value. No evidence can be found in favour of Kapitza's hypothesis, that the crystal structure changes just below the melting point. The allotropic change at about 75° C. is not revealed in the X-ray measurements, although it is indicated in the macroscopic results. J. H. A.

4411. Correspondence between the International and the Thermodynamic Scales of Temperature. W. Heuse and J. Otto. *Ann. d. Physik*, 14. 2. *pp.* 181–184, *July* 12, 1932.—Two platinum resistance thermometers, prepared at different times but both satisfying the requirements of the international scale, have been directly compared with the helium thermometer at a series of temperatures between −43° and −130° C. They agree with each other to within 0·01° C., but there is a systematic divergence from the thermodynamic scale, reaching a maximum of 0·04° C. at about −80° C. These observations confirm earlier ones made with two other thermometers, one of English origin [see Abstract 3141 (1931)]. J. H. A.

4412. Determinations of Fixed Points below 0° C. by Gas Thermometry, with Observations on Vapour Pressure and on Resistance Thermometers. Part II. W. Heuse and J. Otto. *Ann. d. Physik*, 14. 2. *pp.* 185–192, *July* 12, 1932.—The paper is a continuation of earlier work [see Abstract 3141 (1931)], using improved technique, and in particular a new thermostat. The temperatures (on the thermodynamic scale) were measured, and at each point observations were also taken of the vapour pressure of the substance concerned, at pressures near 760 mm. and of the resistances of two platinum resistance thermometers. Results gave for boiling points of N_2, −195·814° C.; CO, −191·484° C.; O_2, −182·963° C.; and for the sublimation point of CO_2, −78·471° C. The result for nitrogen is in good agreement with that found at Leiden, and also with that due to Henning and Heuse. That for CO is confirmed by the Leiden laboratory, and by Verschoyle. The value adopted for oxygen in the international scale is −182·97° C., whilst the carbon dioxide result is 0·012° C. higher than the value previously found by Heuse and Otto. In their earlier work the dispersion of the individual values was much greater than in the present work. J. H. A.

4413. Ebullioscopic Investigations. M. Centnerszwer and M. Lazniewski. *Zeits. f. phys. Chem.* 160. *Abt.A.* 3–4. *pp.* 257–271, *June*, 1932.—The ebullioscope of Swietoslawski, in which superheating is avoided, has been applied to various problems. (1) By solution of diphenyl diketone and of anthracene in benzene, at different concentrations, concordant values for the ebullioscopic constant of benzene are found. The mean is 26·42 in calorimetric units. (2) Similarly, the constant for chloroform is 38·02. (3) By measurement of the apparent molecular weight, as deduced from the elevation of boiling point in chloroform solution, the degrees of association of the four salts isobutyl- and di-isobutyl-ammonium chlorides and bromides have been determined. J. H. A.

4414. Non-Existence of Two Modifications in Nitrobenzene and Carbon Disulphide. E. Murakami. *Chem. Soc. Japan, Bull.* 7. *pp.* 216–221, *June*, 1932. *In English.*—Wolfke and Mazur [see Abstract 2483 (1932)] report discontinuities which would indicate a change of state at temperatures near the freezing point. Massy, Warren and Wolfenden (*J. Chem. Soc.*, p. 91, 1932) have failed to confirm this. The author has also found no trace of the reported discontinuities. A. D.

4415. Freezing Points of Aqueous Solutions. Parts I and II. Potassium, Sodium and Lithium Nitrates. G. Scatchard, S. S. Prentiss and P. T. Jones. *Am. Chem. Soc., J.* 54. *pp.* 2676–2705, *July,* 1932.—Very full details are given of an apparatus for determining the freezing point depressions of dilute aqueous solutions, by a differential method, to within about 0·00002° C.; the solutions are saturated with nitrogen, the concentrations are determined by conductivity measurements, and the temperatures by means of a thermopile. Data are recorded and discussed for solutions of potassium, sodium and lithium nitrates, and ammonium chloride, bromide, iodide, nitrate and sulphate. H. F. G.

4416. Influence of Particle-Size on Melting Point. N. Schoorl. *Zeits. f. phys. Chem.* 160. *Abt.A.* 3–4. *pp.* 158–160, *June,* 1932.—Pawlow's observation that certain substances show a depression of their melting point when very finely divided is confirmed [see Abstract 1148 (1909); 1523, 1524 (1910)]. Two causes of this phenomenon, other than that indicated by Pawlow, are suggested: contact of the substance with particles of devitrified glass, and impurities dissolved by the surface of the substance. Experiments with veronal, luminal, antipyrin, and pyramidone reveal variations in the melting point of as much as 10° C. T. H. P.

4417. Mass and Energy Balance of a Linde Air Separator. W. Meissner. *Zeits. f. techn. Physik,* 13. 6. *pp.* 259–262, 1932. *From the Reichsanstalt.*—The action is described of a double-chamber air separator due to Linde, and its behaviour explained. A complete account of its delivery of nitrogen and oxygen may be derived from a knowledge of the driving pressure and temperature, if the principles of conservation of mass and energy are employed. The theory is given fully. J. P. A.

4418. Separation of Mixed Gases by Reversible Rectification. H. Hausen. *Zeits. f. techn. Physik,* 13. 6. *pp.* 271–277, 1932.—An ideal process of low-temperature separation of air into oxygen and nitrogen is described, and simple equations obtained for the work expended, by considering the heat lost by the mixture and its change in entropy during the process. The conclusion is reached that an approach to thermodynamic reversibility is possible in practice. G. G. S.

4419. Low Temperature Investigations of the Physikalisch-Technischen Reichsanstalt. F. Henning. *V.D.I.* 76. *pp.* 577–580, *June* 11, 1932.—This is a review of the most important investigations carried out at the Reichsanstalt since 1925, when the equipment of the Institute allowed liquid helium to be obtained in Germany for the first time. In a brief review it is only possible to note the divisions of the work which have been chiefly studied, with a few of the most striking results. (1) *Low Temperature Measurements.* Temperatures down to 1° Abs. can be obtained. A diagram is given of the standard precision gas thermometer for constant volume or constant pressure. The accuracy has been considerably increased by measuring the position of the top of the mercury in the manometer by means of glass pointers fused into the tube, and also by keeping the mercury at 0° C. A table of the gas-thermometer corrections is given, and also a table of the boiling and solidifying points of important gases. (2) *Secondary Standards.* The platinum-resistance thermometer has been very carefully investigated. (3) *Vapour Pressure Thermometers.* Many inorganic compounds were investigated. (4) *Investigations on Gases.* Here the work of Holborn and his colleagues on the compressibility of helium, hydrogen, neon, argon and nitrogen must be specially noted. Specific heat results showed the necessity for two forms of hydrogen, *i.e.*, para and ortho. (5) *Investigations on Solids.* The metals have claimed most attention. The properties of single crystals of zinc and cadmium and the general laws of heat and electric conduction leading up to the supraconductivity of metals have been exhaustively treated. The value of the critical (conductivity) temperatures is given for tantalum, thorium, titanium, and niobium, and for several compounds. Perhaps one of the most striking results found is that copper sulphide (CuS) becomes supraconducting at 1·6° Abs. Many nitrides, carbides, borides, and silicides have also been found to be supraconducting. T. B.

4420. Improved Form of Machine for the Production of Liquid Hydrogen. W. Meissner. *V.D.I.* 76. *pp.* 580–582, *June* 11, 1932.—A description of the large liquefier which has been installed at the Reichsanstalt to replace the older and smaller one which was found to be of sufficient capacity for the new hydrogen compressor recently added to the equipment of the low-temperature laboratory. Double the quantity of liquid hydrogen can be produced in the same time as before the installation of the new machine and the efficiency is also very high. T. B.

4421. Temperatures Reached with Solid Carbon Dioxide. J. H. Awbery. *Journ. Sci. Instruments,* 9. *pp.* 200–202, *June,* 1932.—Points out that dry solid CO_2, owing to its rapid evaporation, can fall many degrees below the equilibrium temperature of sublimation. The effect is doubtless due to the fact that solid CO_2 sublimes, instead of melting, so that the solid and the gas, not being confined in a closed vessel, have no opportunity of coming into equilibrium. The temperature is greatly reduced by blowing air over the solid material. J. H. A.

4422. True Specific Heat of Gases at High Temperatures by the Lummer-Pringsheim Method. A. Eucken and O. Mücke. *Zeits. f. phys. Chem.* 18. *Abt.B.* 2–3. *pp.* 167–188, *July,* 1932.—The method consists of observing the fall in temperature when the pressure is suddenly decreased under adiabatic conditions. The initial pressures used were of the order of 10 atmospheres and the decreases of pressure of the order of 100 mm. The molecular heats of O_2, N_2, H_2 and CO_2 were measured between 100° and 600° C., and the values obtained (which are estimated to be accurate to about 0·3 %) are in very satisfactory agreement with theory. The fact that the values obtained in experiments using the sound-wave method are less than those predicted by theory is attributed to the failure of equipartition of energy among the various degrees of freedom of the molecules of the gas, when excited by h.f. sound waves. In support of this it is pointed out that the divergence between theory and the results of sound-wave experiments increases with the frequency of the waves. L. G. C.

4423. Specific Heats of Five Organic Liquids from Their Adiabatic Temperature-Pressure Coefficients. W. T. Richards and J. H. Wallace, Jr. *Am. Chem. Soc., J.* 54. *pp.* 2705–2713, *July,* 1932.—The paper, which is experimental, deals with the determination of the specific heats of benzene, toluene, carbon tetrachloride, chloroform and *n*-heptane, using the thermodynamic relation $\left(\frac{\partial T}{\partial p}\right)_s = \frac{T}{C_p}\left(\frac{\partial v}{\partial T}\right)_p$, where T, p, s and v represent temperature, pressure, entropy and volume respectively. The new data presented are the values of $\left(\frac{\partial T}{\partial p}\right)_s$ for the liquids in question, the temperature range being from 20 to 50° C. for benzene and toluene, and from 20 to 40° C. for the other liquids. The specific heats obtained are believed to be accurate within 0·5 %. L. G. C.

4424. Thermoelectric Methods of Humidity Measurement. L. Kettenacker. *Zeits. f. Instrumentenk.* 52. *pp.* 319–324, *July*, 1932.—Discusses shortly the theory of the wet- and dry-bulb hygrometer, and describes an apparatus using thermojunctions of iron-constantan of 0·1 mm. dia. at most. There is also described a simple arrangement for taking observations without artificial circulation of the air. J. H. A.

4425. Vaporisation Phenomena in Mercury Particles. R. Nestle. *Zeits. f. Physik*, 77. 3–4. *pp.* 174–197, *July* 26, 1932.—By calculation and experiment there is found for normal evaporating mercury particles approximately linear decrease of mass; hence can be determined the order of magnitude of the value of the diffusion coefficient of mercury vapour in various gases. Falling short of the Millikan elementary value of charge occurs only with particles whose vaporisation, especially with spark disintegration, is hindered by chemical action of the surrounding gas such as O or active N. A critical radius beneath which it was supposed falling short must first set in does not exist, as even with large stable particles defect of the electrical elementary quantum is found. In an inert gas like argon also there are usually observed with spark disintegration only vaporising normal particles. [See also Abstract 432 (1927) and following Abstract.] J. J. S.

4426. Vaporisation Phenomena in Mercury Particles. K. Schäfer. *Zeits. f. Physik*, 77. 3–4. *pp.* 198–215, *July* 26, 1932.—The vaporisation of sub-microscopic particles of Hg (radius about 10^{-5} cm.) was calculated with consideration of the rise of vapour pressure at a curved surface, and was experimentally investigated with the Ehrenhaft-Millikan apparatus in the gases, CO_2, H_2, O_2 and air. In pure chemically passive gases a satisfactory agreement between calculation and experiment was found. Measurements were made with these particles of the elementary quantum of electricity, and thereby the results of Sanzenbacher were confirmed [see Abstract 432 (1927)]. The disturbance of the vaporisation, the stable condition of the particles in CO_2 and H_2 is known to proceed from impurities of the gases concerned especially with oxygen. In pure gases, so far as the particles are produced by vaporisation, no stable particles occur, and also no falling short of the elementary electrical charge. [See preceding Abstract.] J. J. S.

4427. Rates of Condensation and Evaporation in Intensively-Dried Systems. The Effect of Intensive Drying on the Accommodation Coefficient of Liquid and Solid Surfaces for Molecules of Their Own Vapours. F. J. Wilkins. *Phil. Mag.* 13. *pp.* 1014–1020, *May*, 1932.—It is shown that the experiments of Michalek and Rodebush which indicate that intensive drying decreases the rate of evaporation and condensation of ammonium chloride without changing its vapour pressure, prove that it also decreases the accommodation coefficient of ammonium

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chloride for its own vapour. A similar conclusion is drawn from the work of Smith which showed that the rate of distillation of ethyl bromide is decreased by intensive drying. These conclusions are discussed theoretically. F. J. W.

4428. Vapour Pressures, Evaporation, Condensation and Adsorption. I. Langmuir. *Am. Chem. Soc., J.* 54. *pp.* 2798–2832, *July,* 1932.—In general, the vapour pressures of liquids (in baryes) can be expressed by $p = AT^{\gamma}\epsilon^{-b/T}$, where A, γ and b are constants. Trouton's rule is equivalent to postulating that $\gamma = 0$ and A is a universal constant. The vapour pressure data of the "International Critical Tables" give log A = 10·65, with a standard deviation (S.D.) of 1·19. Hildebrand's rule is equivalent to taking $\gamma = 1$ and A is then a universal constant for which log A = 7·83 with S.D. = 0·52. Better agreement with the data is obtained by putting $\gamma = 1\cdot5$; log $A_{1\cdot5}$ then equals 6·37 with S.D. = only 0·22. The vapour pressures of solids with rigid vapour molecules are also given by this equation with $\gamma = 1\cdot5$ and log A = 6·9. Much larger values of A are obtained for solids if the molecules possess internal degrees of freedom. These vapour pressure equations may be applied to adsorption phenomena, the rate of evaporation of atoms or molecules from monatomic films on surfaces being given by $\nu = A_{1\cdot5}(2\pi mk)^{-\frac{1}{2}}\Theta T\epsilon^{-b/T}$, m being the mass of an atom in the gas, k the Boltzmann constant and Θ the fraction of the surface covered by adatoms; this agrees well with the experimental data for Th, O and Cs films on W. The conditions are discussed which lead to the formation of monatomic and of polyatomic adsorbed films. In general adsorbed molecules on plane homogeneous surfaces are acted on by strong forces originating from the underlying solid. The resulting polarisation causes the adsorbed molecules to repel one another as dipoles, with forces varying in proportion to M^2r^{-4}, where M is the dipole moment and r the distance. Attractive forces predominate only if adsorbed molecules of two kinds are present—which become polarised in opposite senses—such as Cs and O on W or salt-like substances on metals, such as Hg_2SO_4 on Hg. The equation of state of the two-dimensional gas film is worked out for molecules which repel as dipoles by means of the Clausius virial. By the use of Gibbs' equation for the adsorption isotherm, the rate of evaporation ν can be calculated in terms of Θ, T and M. The equations are found to be of the form required by experimental data for Cs films on W. The Boltzmann equation and the Saha equation then permit of the calculation of the rates of evaporation of electrons (ν_e) and of ions (ν_p) from M(Θ) and T, yielding results in agreement with experiment. The results indicate that the W surface is essentially homogeneous except for about 0·5 % of the surface which holds Cs atoms much more firmly than the rest. T. H. P.

4429. Simple Method of Measuring Low Vapour Pressures. Vapour Pressure of Water over Sulphuric Acid Solutions. W. v. Meyeren. *Zeits. f. phys. Chem.* 160. *Abt.A.* 3–4. *pp.* 272–278, *June,* 1932.—The vapour pressures are measured by means of a vacuum gauge designed by Gaede and not previously described. It utilises the principle of compressing a quantity of gas into a small capillary. Results are given for the vapour pressure of water over H_2SO_4 solutions of strength about 60, 66 and 70 % H_2SO_4 by weight. They are specified exactly by their densities at 15° C., being 1·5111, 1·5654 and 1·6215 respectively. The vapour pressure is given from 0° C. to not higher than 40° C. J. H. A.

4430. Critical Constants and Vapour Pressure of Boron Trifluoride. H. S. Booth and J. M. Carter. *J. Phys. Chem.* 36. *pp.* 1359–1363, *May,* 1932.—The critical temperature of BF_3 is −12·25° C. ± 0·03°, and the critical pressure 49·2 ± 0·01 atmospheres. The vapour pressure at temperatures down to − 50° C. has been determined; it conforms to the equation $\log_{10} p = 5\cdot1009 - 889\cdot6T$. The calculated heat of vaporisation is 59·93 cal. per gm. The liquid becomes noticeably viscous at −50° C. and 13·8 atmospheres, probably owing to association; at the boiling point it appears to be but slightly dissociated. Dry BF_3 has no corrosive action on mercury, chromium plating or glass, even at high pressures and over considerable periods of time. H. F. G.

4431. Vapour Pressure of Chlorine Heptoxide. C. F. Goodeve and J. Powney. *Chem. Soc. J. pp.* 2078–2081, *July,* 1932.—The vapour pressure has been measured by a static method over the range 244° to 303° K. If P is the vapour pressure in mm. of mercury and T the absolute temperature, then $\log_{10} P = 8\cdot03 - 1818/T$. Extrapolation from this equation gives a boiling point of 80° C. against 82° C. observed directly by Michael and Conn in 1900. The vapour-pressure equation leads to a latent heat of evaporation of 8290 cal./mol. The melting point has also been measured for the first time. It was found to be −91·5 ± 2° C. J. H. A.

4432. Measurement of Isothermal Joule-Thomson Effect. A. Eucken, K. Clusius and W. Berger. *Zeits. f. techn. Physik,* 13. 6. *pp.* 267–270, 1932.—A method is described whereby the drop in temperature of a gas on issuing from a nozzle is compensated for by the application of a measured amount of heat to the issuing gas. Reasons are given for the superiority of this method over the usual adiabatic method. The pressure drop across the nozzle, the gas flow and the amount of heat necessary to keep the temperature of the gas constant, are measured, and the magnitude of the Joule–Thomson effect determined from the quantities. A detailed description of the apparatus is given, together with some results for air between 193° and 291° K. and over a pressure range of from 4 to 50 kg./cm^2. G. G. S.

4433. Physical Properties of Compressed Gases. Part III. Hydrogen. W. E. Deming and Lola E. Shupe. *Phys. Rev.* 40. *pp.* 848–859, *June* 1, 1932.—The paper carries out for hydrogen the work already done for nitrogen and carbon monoxide [see Abstract 1673 (1932)]. Compressibility data are smoothed and derivatives obtained and tabulated from − 215° to 500° C. and to 1200 atmospheres. J. H. A.

4434. Van der Waals' Equation. Part I. K. Jablczynski. *Phys. Zeits.* 33. *pp.* 536–543, *July* 15, 1932.—In van der Waals' equation, if a is considered constant, pv^2 is a minimum when $v = 2b$, temperature remaining fixed. This affords a new method of determining b and a independently and from one isothermal. The quantity a, however, varies with the volume and the temperature. For any isothermal, its minimum value coincides with that of pv^2, so that the variation does not invalidate the method. Analysing observations by this means for a number of gases, b is shown to remain constant except very near the critical point. It is possible to obtain values of b with the substance in the liquid state. The variations of a are readily found. For H_2, Ne and He a is negative over wide pressure ranges and at low temperatures, but becomes positive both at low and at high pressures. In hydrogen b increases at low temperatures. The existence of a minimum of pv^2 may be employed as a criterion of other equations of state. Thus Reinganum's equation, which allows a minimum only at absolute zero, must be incorrect. J. P. A.

4435. Equation of State for Gases at Low Densities. D. le B. Cooper and O. Maass. *Canad. J. of Research,* 6. *pp.* 596–604, *June,* 1932.—The equation proposed is of the form $V(1 + KT)(PV - RT) = \lambda T - a$, where P, V, T are the pressure, specific volume and temperature of the gas, R is the usual gas constant, and K, λ and a are constants. The equation is arranged to harmonise with Sutherland's law of viscosity, and exhaustive numerical tests are given, using the data previously given by the authors. [See Abstract 3284 (1931).] J. H. A.

4436. Equation of State of a Non-Ideal Einstein–Bose or Fermi-Dirac Gas. G. E. Uhlenbeck and L. Gropper. *Phys. Rev.* 41. *pp.* 79–90, *July* 1, 1932.—The classical integral suffices if to the Boltzmann factor is added (algebraically) another exponential function, for each pair of molecules. The second virial coefficient consists of three terms, the last two of which only become important at very low temperatures: they are of the same order of magnitude, but of opposite sign. For reasons which the authors discuss, it is at present impossible to say whether isotherm measurements alone permit a decision as to whether or not real gases obey the Bose statistics. F. I. G.

4437. Generalised Formula in the New Statistics. M. K. Gopalaiengar. *Indian Journ. Phys.* 7. *pp.* 251–256, *July,* 1932.—A comprehensive expression is derived, based essentially upon the work of Chandrasekhar [see Abstract 2446 (1930)]. Substitution for degenerate or non-degenerate systems will give the special formulæ required in a number of special cases. The author applies his equation to the following: (1) electrons in equilibrium with metal; (2) chemical equilibria; and (3) the vapour pressure of a crystal. F. I. G. R.

4438. Entropies of Inorganic Substances. K. K. Kelley. *Bureau of Mines, Bull.* 350. [62 *pp.*], 1932.—The trend in metallurgical research is towards application of the methods of thermodynamics to metallurgical reactions. In the present work all the available data referring to one thermodynamical property (entropy) are collected, together with sufficient discussion to make the results readily useful to metallurgists. Values of the entropies at 298·1° K. (25° C.) are given for those elements and common compounds, such as oxides and sulphides, for whose calculation the necessary data are available. A periodic chart is appended of entropy values for elements and compounds, arranged with ample space for subsequent additions; and tables, with necessary explanations, are given of specific heat, entropy and heat of transformation. The paper is to be followed by others of a similar nature. T. B.

4439. Entropy, Strain and the Pauli Exclusion Principle. W. S. Kimball and G. Berry. *Phil. Mag.* 13. *pp.* 1131–1143, *June,* 1932.—In continuation of previous work [see Abstract 2744 (1931)], the " geometrical weight " method is extended to include real gases in which volume is restricted in accordance with van der Waals' equation and energy according to Pauli's principle. The isothermal bulk modulus for gases obeying these restrictions is found to be the same as that of the classical perfect gas, provided molecular attractions are neglected. This is true both for momentum space and ordinary space. The state of maximum entropy or weight for given internal energy corresponds to a state of equilibrium between stress and strain acting in momentum space as well as in ordinary space, just as in the case of a perfect gas. Entropy appears as K times the total strain in phase space, K being Boltzmann's constant. The velocity distribution function represented by these results is the Fermi-Dirac distribution law usually derived by the new statistics and which Chandrasekhar has shown can be derived by the geometrical weight method. The Pauli exclusion principle is interpreted mechanically. Forces acting in momentum space exclude particles from occupied cells just as they are excluded from occupied positions in ordinary space, as represented by van der Waals' constant, *b*. Pauli's exclusive principle is due to the same mechanical tendency as the second law of thermodynamics. Each is a physical aspect of intrinsic processes relating to objection to compression in phase space. J. S. G. T.

4440. Heat Capacity, Entropy and Other Thermal Properties of Carbon Monoxide. J. O. Clayton and W. F. Giauque. *Am. Chem. Soc., J.* 54. *pp.* 2610–2626, *July*, 1932.—Direct measurements have been made of (1) the heat capacity from 14° to 85° K.; (2) the melting point; (3) the transition point between the two solid forms; (4) the latent heat of fusion; (5) the latent heat of the transition; (6) the vapour pressure of the solid variety stable above the transition point; (7) the vapour pressure of the liquid; (8) the vapour pressure of the low temperature solid form (one observation only, but an equation was calculated thermodynamically); and (9) the latent heat of evaporation of the liquid. From these measurements the entropy at the boiling point is calculated as 37·0 cal./mol. per 1° K., or 37·2 when corrected to the state of an ideal gas. The value calculated from spectroscopic data is 38·318, a discrepancy of 1·1 units. It is suggested that this is due to some remaining " orderliness " in the solid at liquid hydrogen temperatures, not contemplated in the application of Nernst's heat theorem. Other data calculated from the data are the free energy (thermodynamic potential) of CO from 250 to 5000° K., and the equilibrium constant of the reaction $C + \frac{1}{2}O_2 = CO$ from 298° to 3000° K. J. H. A.

4441. Quantum Correction for Thermodynamic Equilibrium. E. Wigner. *Phys. Rev.* 40. *pp.* 749–760, *June* 1, 1932.—The probability of a configuration is given in classical theory by the Boltzmann formula $\exp\left[-V/hT\right]$, where V is the potential energy of this configuration. For high temperatures this of course also holds in quantum theory. For lower temperatures, however, a correction term has to be introduced, which can be developed into a power series of h. The formula is developed for this correction by means of a probability function and the result discussed.

AUTHOR.

4442. Position of Thermodynamics in Physics. G. Polvani. *Elettrotecnica*, 19. *pp.* 509–513, *July* 15, 1932.—The importance of thermodynamics in the physical sciences is pointed out. It is described as a synthetic doctrine which comprehends all natural phenomena, and leads to the consideration of the highest problems on the constitution of the universe and on the meaning of the fundamental conceptions of time and space. J. J. S.

SOUND.

4443. Room Acoustics. A. Hirayama. *I.E.E., Japan, J.* 52. *pp.* 398–408, *May,* 1932. *English Abstract.*—The author describes a theoretical study of the reverberation constants of rooms (*a*) for sustained tones, and (*b*) for a regular succession of impulsive tones. He proposes that rooms of average dimensions can be regarded as equivalent to spherical rooms having walls of suitable absorbent and reflecting properties.

A. B. W.

4444. Reflection of Sound Waves in Thin Anisotropic Plates. A. Seiffert. *Zeits. f. Physik.* 76. 5–6. *pp.* 407–414, *June* 7, 1932.—Starting from the fact that anisotropic bodies do not conduct sound waves in the same way as isotropic bodies, the author employs the elliptic wave construction of Huygens to bring out deviations from the laws of geometrical optics which may occur in the case of the propagation of sound waves through thin wood as used in violin making. Consequent on the variation of velocity with direction, the angle of reflection is not equal to the angle of incidence; coincidence of reflected and incident rays takes place along an oblique line; and the virtual image of a point source lies on such a line produced behind the plane reflecting surface; and other results. It is shown how the geometrical properties of reflection in anisotropic plates may be derived by simple orthogonal projection from those for isotropic plates.

G. E. A.

4445. Sound Field of Parabolic Reflectors. K. Satô and M. Sasao. *Phys. Math. Soc. Japan, Proc.* 14. *pp.* 363–371, *July,* 1932. *Imp. Acad. Tokyo, Proc.* 8. *pp.* 281–283, *July,* 1932.—A train of sound waves was incident normally upon a parabolic mirror and the field of sound intensity was investigated by means of a Rayleigh disc and resonator. Notes of five different pitches and mirrors of three different shapes were used, the experiments being performed in a sound-proof chamber. Curves give the variation in intensity of sound along and at right angles to the axis of the mirror, and for two notes the general field of intensity was explored. It was found that when the wave-length of the note was short compared with the diameter of the opening, the sound energy was concentrated at the focus, whilst the intensity falls with increasing distance from the focus as the wave-length increases. With shorter wave-lengths the pattern is similar to that for diffraction of light with a circular aperture.

R. S. R.

4446. Miniature Condenser Transmitter for Sound-Field Measurements. W. M. Hall. *Acoustical Soc. of America, J.* 4. 1. *pp.* 83–93, *July,* 1932.—The problem of sound-field measurements is analysed with a view to indicating the requirements of measuring devices for use in such fields. A condenser transmitter is then described which is an approach towards the ideal set forth in the analysis. AUTHOR.

4447. Use of Acoustic Filters for Noise Damping. K. Schuster and M. Kipnis. *Ann. d. Physik,* 14. 1. *pp.* 123–128, *July* 1, 1932.—An investigation was carried out to find how far it was possible to employ acoustic filters for certain cases of practical interest in noise reduction. In particular, it was found that acoustic filters may be successfully employed in the construction of silencers for the exhaust pipes of internal combustion motors. A type of filter found suitable comprised four tubes about 60 cm. long connected in parallel, each tube having small lateral holes at 5 cm. intervals, and the whole being surrounded by a lead tube lined with damping and heat insulating material. When used on various motors this silencer was found better than the baffle type usually fitted, very little sound issuing from the open end. The new type was found to cause no appreciable loss of power, the loss being only about 1 % in the worst cases, as against values up to 5 % for the old type. [See also Abstract 3355 (1932).] A. W.

4448. Absorption Coefficients of Indian Materials. S. Kalyanaraman. *Indian Journ. Phys.* 7. *pp.* 229–241, *July,* 1932.—The acoustical absorption coefficients of coir mat, sawdust, paddy husk and cushions filled with cocoanut fibre and with cotton, are measured by the stationary-wave method. The source of sound is a valve-maintained tuning-fork, the tube is a large teak enclosure of rectangular section, and the detector, required to measure intensities of sound at nodes and loops, is a tuned hot-wire microphone. The absorption coefficients of the materials in the order given are 0·2 to 0·26, 0·34, 0·35, 0·50, 0·46. J. P. A.

4449. Modern Theories and New Experiments on Acoustic Trumpets. A. Bernini. *N. Cimento,* 9. *pp.* 85–101, *April,* 1932.—A discussion is given of modern theories of acoustic trumpets based on the application of the acoustic impedance, defined analogously to the corresponding electrical impedance. The results already known are briefly considered, and some new results are given derived from experiments on trumpets of various cross-sections which are described. The deduction is drawn that given the simplifications of the theories it would not be prudent to draw from them conclusions of a general nature. J. J. S.

4450. Acoustic Reverberation Measurements with a Completely Automatic Apparatus. M. J. O. Strutt. *E.N.T.* 9. *pp.* 202–212, *June,* 1932.—The automatic relay consists essentially of a microphone connected to a triode used as a saturated diode, which supplies grid-bias to an amplifier valve. So long as the current from the microphone is sufficient to saturate the diode, the anode current of the amplifier is low. As soon as the microphone current falls to a certain value, however, it ceases to saturate, the grid bias of the amplifier rapidly becomes less negative, its plate current rises and operates a relay. The whole equipment incorporates the relay, an amplifier and loud speaker and a timing device which measures the time of decay of the sound from its original value to that at which it no longer saturates the diode. Experiments made with this apparatus confirmed Sabine's observation that in large halls the position of the microphone and loud speaker was immaterial, but it was shown that this is limited in application if the absorbing power of the walls vary considerably from place to place. G. E. B.

4451. Automatic Reverberation Meter for the Measurement of Sound Absorption. W. F. Snyder. *Bureau of Standards, J. of Research,* 9. *pp.* 47–52, *July,* 1932.—The usual electrical recording method for measuring sound absorption in a reverberation room requires the determination of the rate of decay of sound. The automatic reverberation meter described in this paper works through a range of about 70 db, the rate of decay being measured over intervals as short as desired through the whole

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range. An automatic control of the apparatus has been developed which allows measurements to be made with but little attention on the part of the observer. AUTHOR.

4452. Vibrations of Quartz Plates. R. C. Colwell. *I.R.E., Proc.* 20. *pp.* 808–812, *May*, 1932.—By vibrating quartz crystals in an electric circuit Wright and Stuart [see Abstract 312 (1932)] have shown that the crystals break up into different parts while oscillating. The nodal lines thus formed are made visible to the eye by lycopodium powder. In the present paper it is pointed out that the mathematical theory of Chladni plates gives a general equation,

$$\mathrm{A} \cos \frac{m\pi x}{a} \cos \frac{n\pi y}{a} + \mathrm{B} \cos \frac{n\pi x}{a} \cos \frac{m\pi y}{a} = 0,$$

for the nodal lines of square plates. This equation is also applicable to quartz plates in so far as the forms of the nodal lines are concerned. It gives no information regarding the manner of vibration of the quartz. Chladni plates both square and round have been vibrated by mechanical impact from a valve oscillator circuit. A few of the figures thus obtained are shown and may be compared with those of Wright and Stuart. The nodal lines for circular quartz plates do not in general resemble those of circular Chladni plates. AUTHOR.

4453. Loaded String. K. C. Kar. *Indian Phys. Math. J.* 3. *pp.* 103–104, *June*, 1932.—A mathematical note modifying a solution of the equation for the motion of the loaded string used in a previous paper [see Abstract 3272 (1928)] in connection with the theory of the struck string. W. H. GE.

4454. Nature of the Voice-Registers and the Vibrations of the Vocal Cords. J. Obata and C. Satta. *Phys. Math. Soc. Japan, Proc.* 14. *pp.* 341–348, *July*, 1932.—The vowel sounds as sung by vocalists in the low- and high-registers, that is, the chest voice and falsetto, were recorded with all possible care by means of an electrical arrangement, and the acoustical difference of the two registers studied by analysing the records. The results are experimental evidence for the view that the falsetto is produced by reed-like vibrations of the edges of the vocal cords, whereas the chest-voice is produced by the opening and closing of the air passage. AUTHORS.

4455. Rival Theories of Hearing. H. Hartridge. *Roy. Inst., Advance Proof.* [13 *pp.*]. *Received June*, 1932.—The author compares the resonance and telephone theories of hearing and decides in favour of the resonance theory while admitting there are several difficulties to be overcome. J. E. R. C.

4456. Effect of the Head and Ear Passages Upon Sound Fields. G. v. Békésy. *Ann. d. Physik*, 14. 1. *pp.* 51–57, *July* 1, 1932.—Due to resonance of the ear cavity and reflection by the head, the actual sound pressure at the ear drum may be different from the pressure which would exist in the sound field were the head not there. Substituting a hard sphere for the head and a hole drilled in it for the ear passage, the author calculates the ratio of the pressure at the ear drum to that in the undisturbed sound field, assuming the ear drum to be perfectly reflecting. By combining this result with the measurement made by Tröger [see Abstract 2244 (1930)] of the impedance due to the ear drum, a curve is plotted showing the magnification to be expected for a normal ear and head. Magnifications as high as 5 (at 2,400 ~) are predicted. J. E. R. C.

4457. Scattering of Light by Supersonic Waves. P. Debye and F. W. Sears. *Nat. Acad. Sci., Proc.* 18. *pp.* 409–414, *June*, 1932.—The scattering of light passing through a liquid (benzene, CCl_4, etc.) in which h.f. elastic waves are set up by means of an oscillating quartz crystal has been studied by spectroscopic observations. The blue is the most deviated, and the red the least, and as many as ten spectra to the right and to the left of the primary beam have been obtained. The intensity of any given spectrum is a maximum when the plane of the primary radiation is inclined to that of the supersonic waves at a definite angle which depends on the order of the spectrum. The results are interpreted in terms of a theory based on the assumption that each volume of the liquid contributes to the scattering in accordance with Maxwell's equations; the appearance of the higher order spectra is due to the non-sinusoidal form of the variation of the refractive index of the liquid. The experiment may be employed to determine the velocity of sound in a liquid. H. F. G.

4458. New Optical Properties Produced in Liquids by H.F. Sound Waves. R. Lucas and P. Biquard. *Comptes Rendus,* 194. *pp.* 2132–2134, *June* 13, *and* 195. *pp.* 121–123, *July* 11, 1932.—Parallel light passed through water subjected to h.f. ($3 - 15 \times 10^6$ ~) sound waves produced by a quartz piezoelectric oscillator the surface of which is parallel to the pencil, shows diffraction effects similar to those produced by passing perpendicularly through a grating. If α is the deviation of the pencil, maximum illumination occurs when $\alpha = \sin^{-1} p\lambda_1/\lambda_2$, where λ_1 is the wave-length of the light in air, λ_2 that of the sound waves in water and p the order of interference. Light passed through the excited quartz itself shows six or seven spectra each side of the central fringe, the quartz being the seat of stationary elastic waves. When the h.f. sound waves to which the liquid is subjected are of length $\nless 0{\cdot}5$ mm., and still more if $>$ width of the pencil of light, no diffraction spectra appear, but merely a general spreading of the light. This effect increases with the amplitude of the waves, length of path and compressibility of the liquid, and is due to the influence of the varying pressure on the refractive index. C. A. S.

4459. Propagation of Ultrasound in Solid Cylinders (Transverse Waves). R. Ruedy. *Canad. J. of Research,* 7. *pp.* 86–94, *July,* 1932.—The expression giving the phase velocity c with which flexural waves pass through long solid rods is deduced for frequencies varying between zero and over 1,000,000 ~ and rods of any diameter. As the frequency increases, the velocity c increases gradually from very low values toward $c^2 = mE/2s(m + 1)$, reached when the wave-length is much smaller than the diameter of the rod. Published experimental results for transverse waves are in good agreement with the theory given. In general at least four effects enter into the propagation of ultrasound through solid cylinders: first, longitudinal waves, for which the phase velocity decreases toward c as the frequency increases; second, transverse waves, for which the phase velocity increases toward c as the frequency increases; third, pure radial waves at certain frequencies; fourth, resonance effects between the different types of waves, which, on account of the mechanical coupling existing between them, change the natural period of vibration of the rod without affecting the velocity. AUTHOR.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

4460. Measurement of Contact P.D. in Metals. W. A. Zisman. *Rev. Sci. Instruments*, 3. *pp.* 367–370, *July*, 1932.—A new method is described for measuring the contact p.d. between dissimilar metals. It enables the p.d. to be measured to 1/1000 volt in a few seconds of manipulation. An apparatus is described for studying metals in air and another for high vacuum work. AUTHOR.

4461. Determination of Electrometer Capacity. R. Rinkel. *Phys. Zeits.* 33. *pp.* 544–545, *July* 15, 1932.—The principle of the method depends essentially on sharing a charge on the electrometer with a suitable small condenser, and measuring the resulting change in voltage. Suitable condensers are described, which consist of an outer cylinder with a coaxial central electrode, the electrode being insulated by amber. These condensers have a capacity which can readily be calculated, and may be used singly or in combination either as series or parallel arrangements. G. E. B.

4462. Daily Fluctuations in Quadrant Electrometers. H. G. Möller and R. Stoppel. *Zeits. f. Physik*, 77. 3–4, *pp.* 246–249, *July* 26, 1932.—Observations of daily periodicities in plant and animal life led to the observation that quadrant electrometers, from which two of the quadrants had been removed, presented fluctuations with a 24-hour period even when all the parts had been short-circuited. The width of these fluctuations corresponds to some 40 volts between needle and quadrants. Non-electric influences were excluded. In a closed metal chamber electric effects, probably space charges, were observed, even when the free access of air is shut off. Numerous curves show a significant relation to the solar radiation. A. D.

4463. Direct Electrometer Measurement of the Limiting Charge of a Conducting Sphere in an Ionised Electric Field. M. Pauthenier and R. Guillien. *Comptes Rendus*, 195. *pp.* 115–116, *July* 11, 1932.—It is found that, when spheres of steel of 0·5 to 3·5 mm. radius are allowed to fall freely in an ionised cylindrical electric field of 30 cm. dia. and 2 m. height, and their charge is given up to a string electrometer of 5 cm. capacity, the spheres have received a maximum charge. This charge [see Abstract 1324 (1932)] is given by the equation $Q_0 = 3E_0a^2$, where E_0 is the field and a the radius of the sphere, and is verified experimentally. [See following Abstract.] H. M. B.

4464. Charge on Small Dielectric Spheres in an Ionised Electrical Field. M. Pauthenier, (Mme.) Moreau-Hanot and R. Guillien. *Comptes Rendus*, 195. *pp.* 213–215, *July* 18, 1932.—The calculation of the charge now submitted for small dielectric spheres is analogous to that already made for conducting spheres [see Abstract 1324 (1932)], wherein it suffices to replace the induced charges upon the conducting particle by the polarisation charges of the dielectric. For particles of radius beyond a few microns, the limiting charge Q_0 is expressed by the relation $Q_0 = pE_0a^2$, where $p = 1 + 2(\epsilon - 1)/(\epsilon + 1)$, ϵ being the specific inductive capacity, E the intensity of the ionised field and *a* the particle radius. This result has been verified by two different methods, *viz.*, an electrometric process adapted to spheres of radii around 1 mm., and one limited to small spheres of radii 10 to 200 μ based upon trajectories. The particles investigated were of gum lac, ebonite, paraffin and naphthalene. [See preceding Abstract.] H. H. Ho.

4465. Dependence of Ionisation Number on Field Strength and "Mean Ionising Field Strength" in Fluids. A. Nikuradse. *Ann. d. Physik*, 13. 7. *pp.* 851–872, *June* 2, 1932.—A study was made of the dependence of the ionisation number α on the mean field strength E_m and in a special case the following relation was obtained: $\alpha = c(E_m - E_o)$. The proportionality factor c is the same as the exponential coefficient of the current potential equation. The relation holds good if the field strength is not too high. E_o is the field strength at which ionisation starts. As a rough approximation the relation between the α values and the mean field strength for different fluids is a quadratic one, certainly for high field strengths. The dependence of the coefficient c on the electrode distance was investigated. It was also found that E_o varies with the purity of the fluid under test. The greater the purity the higher was the value of E_o. For well purified liquids E_o has a value of about 90 to 120 kV/cm. Well purified toluol was found to have a breakdown field strength of about $1\cdot 3 \times 10^6$ volts/cm. The results in general show that α, c and also the mean ionising field strength E_o depend on the nature of the fluid used. It was found that the relation between the logarithm of the current (log J) and the electrode distance d cannot always be represented by a straight line. In the majority of cases $\partial(\log J)/\partial d$ shows a decrease with increasing value of d. This is certainly the case in different mineral oils and in organic liquids such as nitrobenzol, toluol, hexane, etc. Similar results were obtained in degassed liquids. A. W.

4466. Experimental Study of Parallel-Cut Piezoelectric Quartz Plates. G. W. Fox and W. G. Hutton. *Physics*, 2. *pp.* 443–447, *June*, 1932.—Y-cut piezoelectric quartz plates were studied with respect to the charges developed on the plates when oscillating near their resonant frequencies. The attractive force between crystal and electrode was measured. Two methods for determining the piezoelectric voltage developed across the crystal are suggested. It is concluded from a study of crystal breakage that fracture is due to intense mechanical vibration. AUTHORS.

4467. Variation with Temperature of the Piezoelectric Constants of Quartz. V. Fréedericksz and G. Michailow. *Zeits. f. Physik*, 76. 5–6. *pp.* 328–336, *June* 7, 1932.—The piezoelectric constant d_{11} and the elasticity constant s_{11} of quartz were measured at temperatures ranging from room-temperature to 568° C., the point of interest being that quartz undergoes a transition at 573° C. from the trigonal to the hexagonal system, and in the latter shows no piezoelectric effect. Appreciable decrease in d_{11} was first observed at about 500° C., but its value is only reduced to about a half at 568° C., the highest temperature employed. W. S. S.

4468. Design of Temperature-Control Apparatus for Piezoelectric Oscillators. V. J. Andrew. *Rev. Sci. Instruments*, 3. *pp.* 341–351, *July*, 1932.—The procedure is described for calculating the dimensions of the different components of a temperature control system consisting of conducting and insulating layers outside the thermostat, and absorbing, and in some cases insulating layers between the thermostat compartment and the quartz plate mounting. A method is explained for observing and empirically reducing the effect of variations of room temperature on the controlled temperature of the apparatus. This effect depends on the relative positions of the thermostat, the heater and the quartz plate. It is usually the limiting factor in precision of control. AUTHOR.

4469. Piezoelectric Experiments Employing the Method of Giebe and Scheibe. A. Hettich and H. Steinmetz. *Zeits. f. Physik,* 76. 9–10. *pp.* 688–706, *June* 27, 1932.—The method of Giebe and Scheibe is applied to determine the piezoelectric or non-piezoelectric character of a large number of inorganic and organic crystals [see Abstract 2594 (1925)]. The piezoelectric character of a crystal appears, from the results to be associated with the chemical constitution. Thus, ionic salts, *e.g.*, rock-salt, potassium chloride, fluorspar are non-piezoelectric. The phenomenon occurs quite commonly in the case of homopolar compounds. All heteropolar compounds and molecules (with two possible exceptions) exhibiting the phenomenon contain polar ions or molecules. Bimolecular associated compounds, *e.g.*, hydroxyl compounds, are mostly non-piezoelectric. Of the di-substitution products of benzene the meta-derivatives are pre-eminently piezoelectric. The introduction of a third substituent between two meta-nitro-groups in two series of derivatives does not alter the piezoelectric character of the crystals. An α-glucoside was found to be very strongly piezoelectric; the corresponding β-glucoside exhibited the phenomenon only very feebly, if at all. J. S. G. T.

4470. Waterfall Effect and the Surface Structure of Liquids. A. Bühl. *Kolloid Zeits.* 59. *pp.* 346–353, *June*, 1932.—An atomising apparatus is described for the study of the waterfall (electrically-atomised-water) effect. When various gases are used it is found that the gas atmosphere (*e.g.*, with H_2, CH_4, N_2, CO, air, O_2) does not influence the main result and that atomisation *in vacuo* gives an exceedingly strong electrical effect. The mobilities of the electrical carriers are found to vary over a wide range. The purity of the water greatly affects the electrical yield, electrolytes entirely inhibiting the effect in some cases; experiments are recorded of the atomisation of dilute solutions of the LiOH and KOH and of HCl, LiCl, NaCl and KCl. In the case of colloids, the degree of dispersivity of the sol is of profound influence. The investigation has been extended to other liquids, *viz.*, benzene, hexane, xylene, ethyl ether, acetone, methyl and ethyl alcohols and nitrobenzene, when it was found that only those with a dipole moment gave the waterfall effect. Pure mercury and also the liquid amalgams give the effect, in the case of the former positive carriers being first formed and later negative ones. A Bibliography completes the paper. H. H. Ho.

4471. Electric Charge on an Oil Droplet in an Emulsion. W. C. M. Lewis. *Faraday Soc., Trans.* 28. *pp.* 597–607, *July*, 1932.—The total electric charge density on an oil droplet in an emulsion is calculated on the basis of a balance between the inwardly directed capillary pressure and the outwardly directed electrostatic pressure. On the basis of the existence of an electrical double layer of constant dielectric capacity, expressions are obtained essentially the same as those derived by Knapp [see Abstract 1439 (1922)]. The charge density is shown to be independent of the size of the droplet, and a polydisperse system is therefore possible as an equilibrated system. Comparison of the total charge with the mobile charge responsible for electrophoresis shows the latter to be only a very small fraction of the former even under the most favourable conditions for electrophoretic movement. In view of the mechanism postulated in the above treatment for the attainment of charge, *viz.*, by the adsorption of ions from the continuous medium, it is concluded that the treatment does not apply to those cases, *e.g.*, colloidal electrolytes, in which the charge has its origin in surface ionisation of the colloidal material itself. An examination of the air bubble case indicates that the surface conditions are very different from those at an oil/water interface, the electrokinetic or electrophoretic charge apparently accounts for the total charge in the case of the suspended air bubble. An Appendix deals with the pressure inside a liquid droplet suspended in a liquid or gaseous medium. H. H. Ho.

4472. Electric Wind in Electrical Precipitation in Gases. E. Anderson. *Physics*, 3. *pp.* 23–28, *July*, 1932.—It is at present a moot point what is the rôle played by the electric wind in the electric precipitation process. On the one hand it is held that the electric wind, through its effect on the motion of the particles towards the collecting electrode is the determining factor in the process, while on the other side it is argued that the net action of the wind is unidirectional and that its chief rôle is to promote uniform distribution of the particles in the gas. The electrical precipitation process consists in the "ionisation" of suspended material particles through adhering gas ions, and the consequent motion of these ionised particles to the collecting electrode under the action of the electric field. The author, studying the complex stream of moving ions and gas molecules in a point-to-plate precipitation, concludes that with conducting particles the total rate of precipitation may be determined as much by the rate of ionisation as by the rate of transmission, while with relatively non-conducting particles that tend to hold their charges the rate of deionisation at the electrode is the determining factor. When the transportation or ionisation rate is a determining factor, these being affected by the electric wind, the electric wind affects the precipitation-rate; where the rate of deionisation is the determining factor, the electric wind can have no direct effect on the precipitation rate. A. D.

4473. Electrostatic Potential of Cubic Crystal Lattices. T. S. Wheeler. *Phil. Mag.* 14. *pp.* 56–66, *July*, 1932.—A simple method is described for the calculation of the electrostatic potential of a cubic lattice with regard to the central lattice point. The result is applied to the calculation of the potential of a cubic lattice with respect to a point at the centre of one of the cubes, and the potentials of face-centred and cube-centred cubic lattices with respect to central lattice points. Examples are given (central cæsium ion, central chlorine ion, fluorspar, zinc-blende and cuprite) whereby potentials of crystals involving these lattices are readily obtained. H. H. Ho.

4474. Liquid Currents and Volume Charges at Wire Electrodes in Water. M. Katalinić. *Zeits. f. Physik*, 77. 3–4. *pp.* 257–270, *July* 26, 1932.—In this paper, which continues a previous investigation [see Abstract 2378 (1931)], the author connects together the capillary waves proceeding from a wire electrode under alternating voltage with the liquid oscillations which also occur through the electrostatic repulsion of the charges. As a further consequence of the latter, a unilateral distortion of the a.c. curve occurs, similar to a rectifier effect. A field-strength effect of the conductivity, which occurs in consequence of the h.t. gradients, is provisionally communicated. H. H. Ho.

4475. Dielectric Constants of Alkali Compounds. G. Steulmann. *Zeits. f. Physik*, 77. 1–2. *pp.* 114–116, *July* 19, 1932.—The dielectric constants of potassium salts and the bromides and iodides of lithium and sodium were determined at high frequency by the method of mixtures. The tribasic phosphate and the arsenate of potassium have such an extremely high dielectric constant as to suggest the presence of dipoles within the substance. E. E. F. d'A.

4476. Dielectric Constant of Nitrogen up to 150 Atmospheres at 25°, 75° and 125° C. A. and C. Michels. *Phil. Mag.* 13. *pp.* 1192–1196, *June*, 1932.—The present paper gives the first results which have been obtained with an apparatus designed to measure the combined influence of pressure and temperature on the dielectric constant of nitrogen. The dielectric constant was obtained from the change in capacity of a condenser containing the gas measured by the standard heterodyne beat method. With the exception of the points at 1 and 25 atmospheres (where the small value of $\epsilon - 1$ made the measurements less accurate), the value of the Clausius-Mossotti expression was found to be independent of pressure and temperature, and the dielectric constant at 1 atmosphere and 0° was calculated to be 1·000573. H. H. Ho.

4477. Relations Between the Optical and Dielectric Properties of Ionic Polarisation in Solids. J. Errera and H. Ketelaar. *J. de Physique et le Radium*, 3. *pp.* 239–247, *June*, 1932.—The ionic polarisation of the alkaline halides is correlated with the diameters and deformabilities of the respective ions. Experimental results relating to values of the refractive indices n_0 and specific inductive capacities ϵ, of the fluorides of the alkaline earths, rutile and anatase are tabulated and discussed. It is found that in a homologous series of compounds having a constant number of valency electrodes, *e.g.*, the fluorides referred to, an increase of atomic number of the positive ions and of the inter-ionic distance is accompanied by an increase in the value of n_0. The value of ϵ decreases under these circumstances. These results confirm those obtained for the alkaline halides. Values of ϵ for anatase and rutile are very high, the respective values being 48 and 114. The energy due to ionic vibration is greater in rutile than in anatase. J. S. G. T.

4478. Effect of Temperature Upon the Molecular Polarisation of Gases and Vapours. R. Sänger, O. Steiger and K. Gächter. *Helv. Phys. Acta*, 5. 3. *pp.* 200–210, *June*, 1932.—Experimental data relating to the values of the dielectric constant and density, and the molecular polarisation deduced therefrom are given for water, methyl-, ethyl-, and *n*-propyl-ether and chloride; methyl-, dimethyl- and trimethyl-amine and 1:2 dichlorethane, at temperatures T between 298° and 483° Abs. The following respective values of the constants A and B in Debye's formula for the molecular polarisation P as a function of the absolute temperature T°, *viz.*, $P = A + B/T$, and of the molecular electrical moment μ are derived from the results: water, A, $3 \cdot 76 \pm 0 \cdot 06$; B, 20,970; μ,

$1{\cdot}84_2$ ± 0·008; methyl ether, 15·4; 10,230; $1{\cdot}28_7$ ± 0·010; ethyl ether, 27·6 ± 0·5; 7490; 1·10 ± 0·020; propyl ether, 41·3 ± 1·8; 6350; 1·02 ± 0·05; methyl chloride, 14·1 ± 0·3; 21,390; $1{\cdot}86_1$ ± 0·005; ethyl chloride, 20·9 ± 1·8; 25,180; $2{\cdot}02_0$ ± 0·025; *n*-propyl chloride, 25·3 ± 0·4; 25,710; $2{\cdot}04_0$ ± 0·007; methylamine, 13·4 ± 0·7; 9420; 1·23 ± 0·02; dimethylamine, 17·4 ± 0·2; 5730; 0·96 ± 0·01; trimethylamine, 21·5 ± 0·4; 2230; 0·60 ± 0·02. J. S. G. T.

4479. Polarisation of Hydrogen Molecule. B. Mrowka. *Zeits. f. Physik*, 76. 5–6. *pp.* 300–308, *June* 7, 1932.—The induced electric moment of the H_2 molecule by a unit electric field is calculated by wave-mechanics. The only empirical constants employed are *e*, *m* and *h*. The result is in good agreement with experiment. G. C. McV.

4480. Electric Moment of 1-Halogeno-2:4-Dinitrobenzene. H. Lütgert. *Zeits. f. phys. Chem.* 17. *Abt.B.* 6. *pp.* 460–462, *June*, 1932.—This paper records the electric moments of 1-chloro-, 1-bromo- and 1-iodo-2:4-dinitrobenzene and also of 1-bromo-3:5-dinitrobenzene; and from the ortho-effects the author calculates the moments of the separate substituent groups. As in a previous paper [see Abstract 931 (1932)] it is assumed that the influence of meta- and para-substituents can be neglected in a first approximation. H. H. Ho.

4481. Electric Moment and Molecular Structure. Part VIII. Complex Dipoles and Long-Chain Molecules. C. P. Smyth and W. S. Walls. *Am. Chem. Soc., J.* 54. *pp.* 2261–2270, *June*, 1932.—The results of previous papers have been graphically examined by Ebert and Höjendahl [see Abstract 2063 (1932)], whose conclusions are in essential agreement with those drawn in the original papers. Equations have now been derived for the calculations of the electric moments of molecules of various lengths, containing two, three and four dipoles which may move relatively to one another [see Abstract 2064 (1932)]. The moments of four polymethylene bromides, 1:2:3-tribromopropane, two chlorohydrins, a bromohydrin and two dihalogenated ethers have been determined and the results, together with previously measured values for the glycols, now slightly revised, are compared with the values calculated by means of the equations. It is shown that dipoles not far apart on a carbon chain affect one another's positions in such a way as to diminish the resultant moment of the molecule. The results for the liquids may be explained by supposing that free rotation about the C–C bonds gives a great variety of forms to long-chain molecules, some of which are excluded because of high mutual potential energies of the dipoles, but a more satisfactory explanation is given by the supposition of an extended zigzag structure of the carbon chain with complete freedom of rotation only at the ends of the chain. In these solutions, any considerable bending around of the polar molecules to form ring structures is excluded in most cases. [For Part VII see Abstract 3856 (1932).] H. H. Ho.

4482. Dipole Moments of Organic Nitrogen, Oxygen, Sulphur and Triple-Bonded Compounds. E. Bergmann and Maria Tschudnowsky. *Zeits. f. phys. Chem.* 17. *Abt.B.* 2–3. *pp.* 100–119, *May*, 1932.—From the dipole moments of *p*-fluoro-, *p*-chloro-, *p*-bromo- and *p*-iodoaniline, the characteristic angle of the NH_2 group has been derived as about 42°. The moments of *p*-methyl-, *p*-chloro- and *p*-bromophenyl isocyanide indicate the linear character of the group N = C = S. The constitution of the above products is discussed with respect to the Raman spectrum. From the dipole moments of *p*-fluoro-, *p*-bromo- and *p*-iodo-anisole, as well as from the already known values for *p*-nitro-, *p*-chloro- and *p*-methylanisole, the characteristic angle of the $-OCH_3$ group appears to be constant. By comparison of the dipole moments of diphenylsulphide, *p*-chloro- and *pp'*-dichloro-diphenylsulphide, diphenyl ether, *p*-nitro-diphenyl ether, *p*-methyl-, *p*-bromo- and *pp'*-dibromo-diphenyl ether, the characteristic angle is not constant. The moments of diphenylsulphide, diphenyldisulphide and *pp'*-dinitro-diphenyl disulphide are determined and discussed, as also are those of *p*-chloro- and *p*-iodobenzonitrile, phenylacetylene and *p*-nitrophenylacetylene. The results are adversely criticised by **K. L. Wolf** (*ibid.*, 17. Abt.B. 6. pp. 465–466, June, 1932). H. H. Ho.

4483. Configuration Determination from Dipole Moment Measurements. H. L. Donle. *Zeits. f. phys. Chem.* 18. *Abt.B.* 2–3. *pp.* 146–152, *July,* 1932.—The dipole moments of some 1 : 2-dibromides of the dihydro-dicyclo- and dihydro-tricyclo-pentadienes have been determined in benzene solution, and the cis- and trans-configurations deduced from the data. H. H. Ho.

4484. Interpretation of Dipole Measurements. A. E. van Arkel and J. L. Snoek. *Zeits. f. phys. Chem.* 18. *Abt.B.* 2–3. *pp.* 159–166, *July,* 1932.—It has been shown previously that the boiling-point data of the halogeno-methanes can lead to conclusions with respect to the presence of dipole moments, since these cause an elevation of boiling point which can disturb the additive relations. The measurements now recorded for CBr_3F and CCl_3Br show that these substances are dipole free. The dipole moments of completely chlorinated hydrocarbons, *e.g.*, C_3Cl_8, are zero, while the unsymmetrical unsaturated chlorinated products (C_3Cl_6) possess small dipole moments. The dipole moments of the chloroethanes are practically independent of the nature of the solvent and of temperature. Deviations from the vector rule are discussed in the case of benzene derivatives. The special position of H-ions is discussed at length. An Appendix contains a list of new dipole moments. H. H. Ho.

4485. Dipole Moments of Titanium and Tin Tetrachlorides. H. Ulich, E. Hertel and W. Nespital. *Zeits. f. phys. Chem.* 17. *Abt.B.* 4–5. *pp.* 369–379, *June,* 1932.—Dipole moments of $TiCl_4$ and $SnCl_4$ in CCl_4 and benzene solutions, and the dielectric constants and density measurements of pure liquid and solid $TiCl_4$ and $SnCl_4$ have been determined and deviations from Bergmann and Engel's results indicated. [See also Abstract 3375 (1932).] H. H. Ho.

4486. Free Rotation and Dipole Moments of Organic Compounds. C. T. Zahn. *Phys. Zeits.* 33. *pp.* 525–530, *July* 15, 1932.—Dipole measurements are recorded with the object of finding the constitution of molecules possessing several axes of free rotation. The relationship, however, is too complex for a simple interpretation of configuration, although several characteristics are derivable. The data are: formamide ($\mu = 3 \cdot 2_2$); ethylene chlorohydrin ($1 \cdot 7_5$); ethylene glycol ($2 \cdot 2_5$); ethylene-diamine ($1 \cdot 9_4$); succinic acid diethylester ($2 \cdot 3_0$); formic acid ($1 \cdot 51$).

H. H. Ho.

4487. Measurements of Atmospheric Electricity. V. F. Hess and W. Kosmath. *Gerlands Beitr. z. Geophys.* 36. 4. *pp.* 439–451, 1932.—Conductivity, Λ, and potential gradient, dV/dh, at Lans (Tyrol) during

July–Sept., 1926, were determined by a Wulf electrometer with $50 \times 0{\cdot}45$ cm. dissipation body, and an Elster-Geitel electrometer with polonium-covered platinum foil respectively. λ_+ is always $> \lambda_-$, usually by 1–10 %, but occasionally by considerably more. The maximum, minimum and average values of $\Lambda \times 10^4$ and of dV/dh are respectively 8·19, 1·00 and 2·97, and 206, 30 and 91 volt/cm.; both Λ and dV/dh increase markedly with temperature, or transparency of the atmosphere, slightly with extreme dryness (but little change for variations between 40 and 80 % relative humidity), but decrease slightly with cloud and moderately with wind (strong winds being usually *föhn*); there was little difference in the monthly averages, for the time of day, or for variations in barometric pressure, or wind direction; Λ was lowered by rain. No connection was found between increased conductivity before, and stormy weather after, noon. There were indications of pulses attributable to ion-packets. [See Abstracts 1010 (1928), 755 (1931).] C. A. S.

4488. Thunderstorm Problems. C. E. Deppermann. *Terr. Mag.* 37. *pp.* 179–181, *June*, 1932.—A description is given of phenomena during thunderstorms at Manila in 1931. Lightning only occurred when the cumulus nimbus was capped at cirrus heights; these caps may be grouped under five types. The rapid development of large initial potential and the effect of the different kinds of cloud on the potential are mentioned; a comparison is made between the series of events in a typhoon squall and an ordinary storm. H. M. B.

4489. Globular and Ascending Lightning in Mountains and High Plateaux. E. Mathias. *Comptes Rendus*, 194. *pp.* 2257–2260, *June* 27, 1932.—The author reviews recorded observations of globular and ascending lightning in mountains, and concludes that at high altitudes, despite the intense electric field in the air, globular lightning is rare, except on certain exceptional days of storm. When seen, the colour is white, becoming a more or less pale yellow, at moderate altitudes. The same applies for ascending lightning. These characteristics are explained by the author's theory, in terms of the temperature and pressure changes with increase of height. W. S. S.

4490. Globular Lightning. E. Mathias. *Soc. Franç. Elect., Bull.* 2. *pp.* 729–751, *July*; 865–867; *Disc.*, 867–870, *Aug.*, 1932.—Twenty-three additional occurrences of globular lightning are described, and explained in accordance with the author's theory [see Abstract 1619 (1931)]. In the *Discussion* this theory is called in question as intrinsically improbable, but without any alternate explanation being offered. As regards the "fulminating matter," the author states that its composition must be such that it is formed from and resolved into substances existing normally in the atmosphere, not necessarily of oxygen and nitrogen only. C. A. S.

4491. Auroræ and the Heaviside Layer. E. Brüche. *Zeits. f. techn. Physik*, 13. 7. *pp.* 336–341, 1932.—The author reviews the phenomena of auroræ while still in sunlight, in shadow and in the neighbourhood of the shadow boundary; compares the variation of atmospheric ionisation; and considers the general significance for research on the Heaviside layer during the Polar Year. No evidence is found for the hypothetical ionised hydrogen layer at 400 km. T. L. M.

4492. Apparatus for Registration of the Aurora Borealis. L. Harang. *Terr. Mag.* 37. *pp.* 167–168, *June*, 1932.—The apparatus consists of a small spectrograph of very high light power and having a movable plate holder displaced automatically 3·2 mm./hr. The collimator and lenses are made from the same piece of glass. The lenses are corrected for spherical but not for chromatic aberration. The slit is arranged to point north with an elevation of 60° and the great aperture of the lens provides for examination of a large part of the sky. The period Nov. 24–26, 1930, gave unusually brilliant auroræ and the very intense quiet auroral forms were registered on the 25th and 26th. An eruptive prominence was observed at Greenwich to be blown out from the sun on Nov. 25th and the occurrence affords an example of the close connection between great sunspot activity and brilliant auroræ. R. S. R.

4493. Registered Observations of Cosmic Radiation at Sea-Level in Stockholm. F. Lindholm. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 23*A*. 4. [20 *pp*.], 1932. *In German.*—An account of observations made in Stockholm with comments on the results of various other investigators. Tables and curves showing the results of the daily records are given for the open apparatus and that screened with 10 cm. Pb. No such clear results were found at sea-level, as at Muottas-Muraigl, either for the hard or weak radiation. No intensity increase with a maximum occurring at midday in all series was found. The daily period is clearly seen with the open apparatus if the afternoon values are compared with the forenoon values, but this is not the case with the hard radiation. A weak midday maximum may perhaps exist in the hard radiation, whilst with the weak radiation the afternoon maximum is especially pronounced. J. J. S.

4494. New Method of Measuring Cosmic Radiation in Great Depths of Water. R. M. Sievert. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 23*A*. 6. [5 *pp*.], 1932. *In German.*—A description is given of an arrangement suitable for the measurement of the ionisation produced by cosmic rays in water down to depths of 1000–2000 m. or more. From its simplicity it can be applied to the carrying out of several simultaneous series of measurements without too great cost. The method described differs from that used by Regener partly through the way of measuring the ionisation, partly through the way of producing the gas pressure in the ionisation chamber. J. J. S.

4495. Coincidence Measurements of Cosmic Radiation. J. N. Hummel. *Phys. Zeits.* 33. *pp*. 503–505, *July* 1, 1932.—A description is given of an apparatus by which the capacity of coincidence in dependence on the possibility of ionisation in observations on cosmic radiation and also the specific ionisation through coincidence measurements can be directly determined. In the arrangement a counting tube is divided into two chambers (or in a modification into three) by an insulating partition so that the independent discharge in the one chamber does not extend into the other. Thus measurements can be obtained of two-fold or three-fold coincidences. J. J. S.

4496. Intensity of Cosmic Radiation at an Altitude of 16,000 Metres. A. Piccard, E. Stahel and P. Kipfer. *Comptes Rendus,* 195. *pp*. 71–72, *July* 4, 1932.—In the ascent of May 27, 1931, in a free balloon, the cosmic radiation in the upper regions of the atmosphere was observed by two methods: the ionisation chamber and the Geiger-Müller counter.

In the ionisation chamber a mean ionisation of 1550 pairs of ions per c.c. per sec. was found at a height between 15,500 and 16,000 m. This, when reduced to the ionisation of normal air, gave an ionisation I = 197 pairs of ions per c.c. per sec. Observations with the Geiger-Müller counter also showed a very strong increase of the cosmic radiation at 16,000 m. A good interpretation of the results, however, requires the taking of other measurements at intermediate altitudes. The value of the ionisation found is situated on the prolongation of the curve giving, according to Kolhörster, the ionisation up to 9300 m. J. J. S.

4497. Mechanism of Cosmic Radiation. D. Skobelzyn. *Comptes Rendus,* 195. *pp.* 315–317, *July* 25, 1932.—A discussion is given of the results of a series of observations on cosmic radiation by the method which shows the trajectories of ultra β-rays. The single group observed with four trajectories shows a beam which diverges from below upwards. Three of the trajectories prolonged downwards cut the fourth at different levels. There is thus a corpuscular ray of very high energy emitted from below upwards which has produced three branches at three different points of its path. On three plates pairs of trajectories issuing from the same points were observed. The intersection is visible in one of the three cases. Amongst the other groups observed there are six cases of convergence of two rays upwards. In one of these cases where the emission of two rays takes place from the same centre the two directions make an angle of 98°. New phenomena seem to be present in which interaction occurs between a radiation of very high energy and the nucleus of the atom, phenomena of which the complete interpretation within the frame of ordinary dynamics may not perhaps be possible. J. J. S.

4498. Analysis of Cosmic-Ray Observations. L. D. Weld. *Phys. Rev.* 40. *pp.* 713–717, *June* 1, 1932.—A method of rendering non-linear observation equations susceptible to least-square adjustment is adapted to observations on the absorption of cosmic rays in various depths of water, data on which have appeared from time to time; the object being to obtain the most probable values of the constants of the assumed discrete components of the radiation. Applied to the most consistent data so far published, *viz.*, those reported by Millikan and Cameron [see Abstract 2718 (1931)], the adjustment shows that the quantitative conclusions deduced from them by the observers are not derivable from the data by the method of least squares. AUTHOR.

4499. Diurnal Variation of Cosmic Rays. R. D. Bennett, J. C. Stearns and A. H. Compton. *Phys. Rev.* 41. *pp.* 119–126, *July* 15, 1932.—The intensity of cosmic rays at an altitude of 3900 m. was measured hourly over a consecutive period of 240 hours. The procedure eliminated the effects due to the variations of the temperature and possible variations of pressure of the gas in the chamber. The ionisation was about $1 \cdot 5 \pm 0 \cdot 25\ \%$ more between 8 a.m. and 4 p.m. than between 8 p.m. and 4 a.m. If the variation is due to the soft component of the cosmic rays, these results are in satisfactory agreement with the results of other observers. Analysis of the data suggests that the portion of the space in the neighbourhood of the sun may emit cosmic rays more copiously than the remote regions. This makes doubtful the inference that the energy in the universe in the form of cosmic rays is comparable with that in the form of light. AUTHORS.

4500. Theory of Magnetic Storms. S. Chapman and V. C. A. Ferraro. *Terr. Mag.* 36. *pp.* 77–97, *June*; 171–186, *Sept.*, 1931, *and* 37. *pp.* 147–156, *June*, 1932.—The authors present in the three papers a portion of their theory of storms as caused by currents in the earth's atmosphere. It is assumed that solar corpuscles are the primary cause of the storms. They form a stream which is electrostatically neutral but ionised and which does not carry an appreciable current nor possess an appreciable magnetic field. At the distance of the earth the density of the solar stream will lie between 2×10^9 and 20 ions per c.c., and the speed will be at least 10^8 cm./sec. The corpuscles move out radially from the sun, but as the sun rotates the outline of the stream becomes curved, so that a continuous stream will reach the earth on its post meridian side, and the surface of the stream will cross the earth in about 35 sec. Calculations are made of the mean free path of the electrons, the coefficient of diffusion of ions and electrons relative to one another, and the electrical conductivity of the gas. The authors confirm one of Chapman's main conclusions, namely, that within the stream the ions and electrons can move together nearly rectilinearly, without spiralling, and with only a slight deflection by the field. The tendency of the field to separate them is resisted and a slight polarisation of the stream results. Surface effects are of primary importance in the production of a magnetic storm. These are of three kinds which are exemplified. In the first typical case, an infinite plane-slab stream moves through a uniform field; the surface charge is stable and neutralises the deflecting tendency of the magnetic field on the particles inside the stream. In the next case a cylindrical stream of any section moves through a uniform field; the charge is repelled from the surface and tends to escape. The third effect appears with the other two when a stream moves into a non-uniform field, *e.g.*, a region of increasing intensity. In addition to increased polarisation and surface charge, electric currents are induced in and near the surface of the stream, and these tend to maintain the magnetic field uniform inside the stream. This third effect is the cause of the initial phase of a storm, whilst the second is important in producing the main phase. G. E. A.

4501. Electric Field in Terrestrial Magnetic Storms. A. H. R. Goldie. *Roy. Soc. Edinburgh, Trans.* 57. 1. *pp.* 143–177, 1931–1932.—The diurnal variation of magnetic force on disturbed days can be regarded as a magnification of a certain irregularity present even on quiet days. In latitudes where the magnetic displacements attain their greatest development, a magnetic storm is in the main a diurnal variation. On quiet and disturbed days the electric field responsible for the diurnal variation of magnetic force appears to be generated mainly in the tropical and subtropical regions of the sunlit hemisphere, in all probability by dynamo action, and this action is regarded as the prime cause of magnetic storms and auroræ. The position, direction and strength of the electric currents capable of producing the displacements recorded at Lerwick, Eskdalemuir and Abinger in selected groups of storms are computed. The current centre is near Lerwick, at a height from 100 to 500 km., coming from W.S.W. in the afternoon, and changing round to E.N.E. after 1 a.m. Midwinter and quiet years are characterised by currents low in strength and altitude, and considerably inclined to the W.E. direction. The opposite features characterise other parts of the year and the means for disturbed years. The generation of an electric field of the necessary intensity is consistent with the existence of a higher atmosphere which during the day is electrically conducting down to 90 km., and during the night down to 200 km., and with certain other specified requirements, including an air speed of 1 m./sec. A diagram of the electric current system in northern latitudes in well-developed storms is drawn, the total current being of the order 500,000 amperes. Consideration is given to the part that electrical forces may play in modifying or controlling the movement of the atmosphere at great heights. G. E. A.

4502. Magnetic Convergence Mapping. W. I. Ingham. *Mines Mag.* 22. *pp.* 7–8, *July*, 1932.—A method is described for plotting convergence contours, which bring out the magnetic structure of an area more vividly than the contour lines through places of equal magnetic anomaly. C. A. S.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

4503. Influence of Temperature and Field Strength on the Electrical Conductivity of Amber. F. Seidl. *Zeits. f. Physik*, 76. 9–10. *pp.* 565–575, *June* 27, 1932.—The conductivity of clear natural amber is measured at 20 to 22° C. and at − 184·3° C. using field strengths up to 10,000 volts/cm. An anomalous change in the direction of the current at constant applied potential is observed in the temperature range 20° C. to 22° C.; this is observed in three separate specimens. The conductivity of natural amber which has attained a clouded appearance in the laboratory is also measured and found to be roughly ten times as high as that of the clear unclouded specimens. J. E. K.

4504. Current Conduction in Dielectric Liquids. W. O. Schumann. *Zeits. f. Physik*, 76. 11–12. *pp.* 707–719, *July* 12, 1932.—The current curves of very pure insulating liquids lead to the result (1) that the current in the saturation region and below is actually carried by negative particles, (2) that the negative carriers are produced for the most part at the kathode, (3) that with high field strengths collision ionisation occurs whereby the electrons produced by collision for the most part immediately again accumulate and form negative ions. With nitrobenzol the accumulation action is greater than the ionisation action so that with sufficient layer thickness a current of negative ions of ohmic character occurs. With toluol, on the contrary, the ionisation action is greater than the accumulation, so that the current with equal field strength continuously increases with the striking distance. J. J. S.

4505. Anomalous Conductivity in Pure Liquids. H. Garrigue. *J. de Physique et le Radium*, 3. *pp.* 248–263, *June*, 1932.—Anomalies in the electrical conductivity of pure acetone, nitrobenzene and benzene are investigated experimentally and discussed. The values of the apparent resistance of columns of these liquids are found to oscillate with the passage of time independent of the nature of the electrodes. A theory of the phenomenon is developed and verified experimentally. J. S. G. T.

4506. Electrical Conductivity of Powders. Part V. A. Völkl. Part VI. P. Guillery. *Ann. d. Physik*, 14. 2. *pp.* 193–220, *July* 12, 1932. —A new method for the measurement of the electrical conductivity of half conductors is described which is more especially valuable in the case of those substances which are only available as finely grained powder.

The method consists in mixing the substance to be tested with a good insulator and using this mixture as dielectric of a condenser in an oscillating circuit. From the dampings of the circuit measured with various wavelengths the conductivity of the substance examined can be obtained. The trustworthiness of this method was tested by measurements on crystalline CuO (as electronic conductor) and AgCl (as electrolytic conductor). The method should be suitable for the solution of many questions on the nature of electric conduction in half conductors. Various half conductors were examined by the method and their conductivity found to be greater than that given by the hitherto usual method of testing in the form of pastilles made by pressure or melting of the powdered substances. J. J. S.

4507. Effective Resistance of a Condenser at Radio Frequencies. E. B. Moullin. *Roy. Soc., Proc.* 137. *pp.* 116–133, *July* 1, 1932.—The resistance of a h.f. circuit usually exceeds the calculated resistance of the inductance coil and the discrepancy is often attributed to the condenser. This paper describes an experimental method of separating the total resistance into a component due to the resistance of the conductors of the coil and a component independent of the coil. Similar coils wound with wire of different specific resistance are used and the measured resistance of the circuit is plotted against the calculated resistance of the coil. The result is a straight line not passing through the origin: thus there is a component of resistance not depending on the conductivity of the wire in the coil; the intercept on the resistance axis shows the resistance of the condenser at the frequency in use. The slope of the line gives a measure of the amount by which the true resistance of the coil exceeds the calculated resistance and hence the self-capacity correction may be examined. The coils used were long narrow rectangles; for such the skin effect formula for a long straight wire is applicable. For frequencies between 3 and 10 million $\sim$ the measured resistance of a wire agrees with the calculated value. J. J. S.

4508. Absolute Measurement of the H.F. Conductivity of Liquids for Wave-Lengths of 3 Metres. H. Schaefer. *Zeits. f. Physik*, 77. 1–2. *pp.* 117–122, *July* 19, 1932.—A description is given of apparatus and method of use for determining the h.f. conductivity of liquids for a wavelength of 3 m. The liquid under test is used as the dielectric of a special condenser forming part of an oscillatory circuit whose decrement is measured. The construction of the condenser is such that the absolute value of the conductivity of the liquid can be directly evaluated. Experimental errors may be of the order of 8 %. Application of the method to colloidal organic solutions gives an increase of conductivity at the high frequency employed of over 100 % of the conductivity at medium frequencies. A. W.

4509. Resistance at a Vacuum Junction. T. Takéuchi. *Phys. Math. Soc. Japan, Proc.* 14. *pp.* 296–298, *June*, 1932.—In the first part of the paper, the expression representing the current flowing between two bodies in contact is defined by considering the number of vacant levels in the bodies. In the second part, the resistance at the vacuum contact of two identical metals, either at the same temperature or at different temperatures, is obtained, as an appendix to Frenkel's work. AUTHOR.

4510. Theory of Rectification. A. H. Wilson. *Roy. Soc., Proc.* 136. *pp.* 487–498, *June* 1, 1932.—Certain crystal contacts will rectify a.c., but no entirely satisfactory theory has yet been given. The one most generally accepted is that due to Schottky, who, however, has been led by more recent experiments to doubt the adequacy of the theory. It seems to the author that the original Schottky theory, together with the new theory of semi-conductors, offers a reasonable explanation of a large part of the phenomena associated with crystal detectors. The existence of the large additional resistance seems to demand a quantum-mechanical tunnel effect as its cause. The theory developed by the author in this paper differs from those hitherto proposed in several important aspects. The essential point is that it is the p.d. which causes the asymmetry in the current. The p.d. between the two components changes the number of electrons which can pass from one component to the other, while the high field only affects the transmission coefficient and makes the passage of the electrons easier or more difficult. Though the difficulties in the way of a complete theory of the transmission coefficient are considerable, the crude theory explains a large part of the phenomena. J. J. S.

4511. Nature of Electrical Conductivity of Cuprous Oxide. H. Dünwald and C. Wagner. *Zeits. f. phys. Chem.* 17. *Abt.B.* 6. *pp.* 467–470, *June*, 1932.—The conductivity between 800° and 1000° C. depends on the partial pressure of oxygen in the surrounding gas atmosphere. From the measurements of the thermoelectric forces it is concluded that there is so-called " defect conduction " of the electrons of the substance. H. N. A.

4512. Dispersion Theory in Metallic Conductors. Y. Fujioka. *Zeits. f. Physik*, 76. 7–8, *pp.* 537–558, *June* 20, 1932.—Investigation is made of the behaviour of the electrons according to the quantum-mechanical electron theory in metallic conductors under the influence of a continuous periodic external field. If the alternating action with the lattice vibrations is not considered there is obtained for high frequencies the usual dispersion formula, and for low frequencies a relation which is similar to the Thomson scattering formula for free electrons. The alternating action of the electron motion with the lattice vibrations can, according to Kronig, be conceived as a damping effect. This damping is calculated from the transition probabilities which are induced by the lattice vibrations. The result of the numerical estimation agrees with experiment so far as order of magnitude is concerned. J. J. S.

4513. Interaction of Lattice Vibrations and Free Electrons in Metals. H. Jones. *Cambridge Phil. Soc., Proc.* 28. *pp.* 367–385, *July* 30, 1932.—In this mathematical paper the interaction between the lattice vibrations and the electron system of a metal in thermal equilibrium is considered, and its effect on the specific heat per electron determined. The results so obtained, giving the temperature dependence of the electron specific heat, are compared with those obtained experimentally for the temperature dependence of the Thomson coefficient for the same metals. J. J. S.

4514. Measurement of Boltzmann's Constant by means of the Fluctuations of Electron Pressure in a Conductor. H. D. Ellis and E. B. Moullin. *Cambridge Phil. Soc., Proc.* 28. *pp.* 386–402, *July* 30, 1932.—A repetition of J. B. Johnson's determination of Boltzmann's constant by observing the thermal agitation of electrons in a conductor is described. The principle of the measurement and the various sources of error are examined. The attenuator system of the calibrating circuit is discussed in detail. J. J. S.

4515. Bloch's Integral Equation. J. Winter. *Comptes Rendus,* 195. *pp.* 33–34, *July* 4, 1932.—The theory which leads to the establishment of Bloch's integral equation does not take account in an absolute manner of the principle of the conservation of energy in the electron-wave elastic collisions. The author has calculated the coefficients of transition (or of diffusion) of the electrons in the electronic theory of metals, adopting conditions of permanent régime which rigorously obey the conservation of energy. A finite diffusing volume subjected to elastic waves is considered. The problem consists in a calculation of perturbation starting from the equation of Schrödinger. J. J. S.

4516. Hall Effect in Bismuth Single Crystals. H. Verleger. *Zeits. f. Physik,* 76. 11–12. *pp.* 760–765, *July* 12, 1932.—Single crystals of Bi, prepared by Bridgeman's method, were used in systematic measurements of the Hall effect. The vector formula of Voigt is verified; the experimental constants are $-10\cdot2$ and $-1\cdot33$. The value of the Hall effect exceeds as usual those given by theoretical considerations. T. L. M.

4517. Hall Effect with Audio-Frequency Currents. L. A. Wood. *Phys. Rev.* 41. *pp.* 231–238, *July* 15, 1932.—The Hall e.m.f. in tellurium has been investigated with currents of frequencies up to 25,000 ~, with particular reference to any effect of frequency on the magnitude of the Hall coefficient R_H, and on the phase of the Hall e.m.f. relative to the longitudinal current producing it. A Hartley-circuit valve oscillator furnishes the current for the specimen, which is placed in a constant magnetic field of about 3000 gauss. The Hall e.m.f., amplified by a resistance-coupled valve amplifier, is observed on a kathode-ray oscillograph. A general method of procedure is indicated for use in comparing alternating e.m.f.s as small as a few mV or less with respect to magnitude and phase. The current drawn and the power consumed are entirely inappreciable. The results of a comparison method of this sort and a null method agree in the conclusion that, in the range studied, the Hall coefficient for tellurium is constant to within about 2 % for frequencies up to 10,000 ~ and to within 7 % for the complete range. This agrees with the results of Smith on bismuth. For the specimen used the value found for the Hall coefficient is $R_H = 481$. The two methods also agree in finding the frequency, wave-form, and phase of the Hall e.m.f. the same as those of the longitudinal current producing it. The phase difference, if any, is believed to be less than 2° at frequencies below 20,000 ~ and less than 4° at 25,000 ~. AUTHOR.

4518. Thermomagnetic and Galvanomagnetic Properties of a Bismuth Crystal. H. E. Banta. *Phys. Rev.* 41. *pp.* 239–250, *July* 15, 1932.—The fractional changes, due to a magnetic field, in the electrical conductivity, in the thermal conductivity, and in the thermoelectric power of a single bismuth crystal are measured in these experiments. These changes are determined as a function of the field strength, of the direction of the field, of the direction of the crystal axis, and of the direction of the heat and electric currents through the crystal. An electric current sent through the crystal cools one junction and heats the other by the Peltier effect. The temperature difference thus produced gives rise to a thermal e.m.f. in the crystal circuit. Observations of this e.m.f. allow the calculation of the fractional changes produced in the thermal conductivity and in the thermoelectric power. The change of electrical conductivity is influenced much more strongly by the crystal structure than is the change of thermal conductivity. Crystal structure and orientation of the magnetic field both affect strongly the change in the thermoelectric power. The theory of electrons in metals in its present form does not give an adequate explanation of the results. If the magnetic field changes the free electron density in bismuth some of the results may be explained in a general way. AUTHOR.

4519. Thermoelectric Action between α- and γ-Iron. O. Tesche. *Zeits. f. techn. Physik*, 13. 7. *pp.* 310–312, 1932.—The combination α–γ iron which usually shows no thermoelectric effect can be made to give a small transitory e.m.f. of 5×10^{-4} volt if part of the iron wire after heating to 900° C. is suitably quenched with water. Microphotographs of the two parts of the wire are shown. H. M. B.

4520. Supraconductivity of Alloys Containing Gold and Silver. J. C. McLennan, J. F. Allen and J. O. Wilhelm. *Phil. Mag.* 13. *pp.* 1196–1209, *June*, 1932.—This paper deals with the alloy systems Ag-Sn, Au-Sn, and Au-Pb, full details being included. Two outstanding features were discovered: (1) In alloys with the supraconductive elements, Au and Ag produce an effect on the transition temperature which is the opposite of that produced by Bi, Sb and As. (2) A binary alloy system composed of one supraconductor and one non-supraconductor does not necessarily have a unique transition temperature. Eutectics are inferred to be more stable as regards supraconductivity than are compounds, or, more generally, than are proportions other than eutectics. The system Ag-Sn furnishes a striking example of the variation of residual resistance as the change in proportion takes place from pure tin, through the various alloys, to pure silver. The results now obtained bear out the de Haas theory, that between the crystal faces in the mixed structure of an eutectic there must exist forces of considerable magnitude which cause supraconductivity to appear at temperatures other than would be expected. That these internal forces must be of greater magnitude in eutectics than in compounds for alloys of proportions other than eutectic is essential from the nature of the latter, since this, having the lowest melting point, must represent the proportion in which the greatest internal forces are present. H. H. Ho.

4521. Measurements with the Aid of Liquid Helium. Part XIX. Lead-Thallium and Lead-Bismuth Alloys. W. Meissner, H. Franz and H. Westerhoff. *Ann. d. Physik*, 13. 8. *pp.* 967–984, *June* 20, 1932.—The curve of transition point against composition for the Pb-Tl series of alloys is a complicated one with a maximum and a minimum in it. The transition is by no means sharp, extending over nearly 5° C. at 40 % of Pb (atomic percentage). For the Pb-Bi series, the curve is distinctly more regular. It rises, though with changes in gradient, from 0 to beyond 93 % Pb, being then at about 8·9° K. The fall to the very low value for pure Bi is accomplished in the last few stages of the concentration range. J. H. A.

4522. Strength of Persistent Currents in Supraconducting Circuits. J. C. McLennan, J. F. Allen and J. O. Wilhelm. *Phil. Mag.* 14. *pp.* 168–180, *July*, 1932.—Currents were induced in similar rings of tin, lead and tantalum at liquid helium temperature by sending a current through a concentric and coplanar copper ring. The magnitude of the current in the ring under investigation was determined by measuring its own torsion in the field of the copper ring. The rate of change of flux through the experimental ring does not affect the persistent current, and the latter, for tantalum and lead, is proportional to the total flux through the ring. In the case of tin, this proportionality holds only up to a certain flux, but up to this point all three metals give the same constant of proportionality, showing that inductance alone is effective. The anomaly in the case of tin is probably due to part of the ring lying in a field sufficient to destroy the supraconductivity. Temperature is also without influence on the current, so that no evidence can be given as to the existence or non-existence of a residual micro-resistance. J. H. A.

4523. Electrodeless Discharge through Hydrogen in a Long Tube. B. Arakatsu and K. Kimura. *Faculty of Sci. and Agri., Taihoku Imp. Univ., Mem.* 5. *pp.* 15–23, *March,* 1932. *In English.*—Discharges were produced in hydrogen contained in a tube about 1 m. long. Round the centre of the tube, but not touching it, was a coil of 10 turns, the coil length being 10 cm. Through this coil heavy condenser discharges were passed at the rate of one or two per sec., the current reaching some thousands of amperes in a period of about 10^{-5} sec. The changes observed in the discharge as the pressure of the gas was reduced from about 0·5 mm. are described in detail. In the first stage the glow was pale white, the spectrum being continuous from the yellow to the limit of the visible spectrum in the violet. At about 0·2 mm. H_β was visible in the continuous background, while H_α could hardly be detected, and a weak Fulcher band was sometimes observed. At about 0·1 mm. the colour changed abruptly to light pink extending somewhat beyond the ends of the coil, the lines H_α, H_β and H_γ being then seen brilliantly on a weak continuous background. Further evacuation caused the glow to extend, and at about 0·01 to 0·005 mm. its length was about 50 cm. No striations were apparent, but the colour of the glow was brilliant pink-white somewhat tinted with blue-violet at the centre; just beyond the ends of the coil the colour was pink-red, while the ends were deep red. The spectrum of the light from the centre was similar to that of the ordinary Geissler tube discharge. The Balmer lines developed well in the second portion and the spectrum of the end portions was similar except for differences in the intensity distribution among the lines and the sharpness of the association of the continuous spectrum with the last visible line of the Balmer series. The results of the observations are discussed. A. W.

4524. Influence of Humidity on the Discharge Potential in Air. C. Dei. *N. Cimento,* 9. *pp.* 150–155, *May,* 1932.—The discharge voltage between aluminium disc electrodes 1 cm. in diameter and 8 mm. apart in air saturated with water vapour and at a total pressure of 11 cm. at 18° C. falls from 4680 to 4300 on reducing the temperature from 18° to −17° C. On further reduction of the temperature to −55° the voltage falls to 4120, and thereafter it remains practically constant. H. F. G.

4525. Influence of Salts on the Minimum Discharge Potential. W. Gräwe. *Phys. Zeits.* 33. *pp.* 483–488, *June* 15, 1932.—The minimum discharge potential in nitrogen or air at various temperatures and pressures is not altered if the positive electrode is coated with a salt. With a coated negative electrode, however, the potential falls, the decrease being greater the higher the temperature, especially at low pressures, and dependent on the quantity of salt present. Salts which evaporate easily, such as cadmium iodide and mercuric chloride, are without effect. Salts of boric and phosphoric acid are active, although the free acids are inert, so that the electrons emitted from the coatings originate in the kation. The effect is ascribed to ionisation of the gas molecules by collision with electrons emitted from the salt as a result of the impact of positive ions. H. F. G.

4526. Kathode Fall in the Arc Discharge. P. Bächtiger and M. Wehrli. *Helv. Phys. Acta,* 5. 3. *pp.* 161–165, *June,* 1932.—Values of $n\overline{U}$, where n is the number of ion pairs produced by an electron and $\overline{U}$ the mean loss of speed experienced by the electron during formation of an ion pair, are calculated for the case in which the extent of the space-charge region at the kathode is smaller than the mean free path of the electrons. It is shown theoretically that the slope of the isotherms of $n\overline{U}$, at constant kathode temperature, increases with decreasing current. H. F. G.

4527. Test of Compton's Arc Theory. L. S. Ornstein, H. Brinkman and A. Beunes. *Zeits. f. Physik,* 77. 1–2. *pp.* 72–81, *July* 19, 1932.—The temperature of the arc is determined as a function of the pressure by observations of the intensity of the cyanogen bands. Compton's theory of the arc explains the current densities on taking into account the easily ionised gases appearing as impurities out of the electrodes. E. E. F. d'A.

4528. Kathodic Part of Glow Discharge. Part I. Atom Processes. E. W. Pike. *Phys. Zeits.* 33. *pp.* 457–467, *June* 15, 1932.—Summarises the results of recent work on the individual processes occurring in gas discharges. The paper deals with (*a*) ionisation by collision, (*b*) motion of electrons and ions in gases, (*d*) emission of electrons from metal surfaces, (*e*) action of metastable atoms and " imprisoned radiation." An extensive Bibliography is appended. W. E. P.

4529. Conveyance of Slow Positive Particles through Canal Rays. J. Koenigsberger. *Ann. d. Physik,* 13. 7. *pp.* 780–782, *June* 2, 1932.—A discussion of the observations and views of various investigators as to the existence and nature of these particles. J. J. S.

4530. Positive Column of a Caesium Discharge. F. L. Mohler. *Bureau of Standards, J. of Research,* 9. *pp.* 25–34, *July,* 1932.—An account of an investigation of the sources of power dissipation in the positive column of a caesium discharge. The power input per cm. of a uniform column is equal to the voltage gradient × the current. The voltage gradient was measured by probes at the axis of the discharge tube. Two sources of power dissipation are the recombination of ions on the tube walls and the atomic radiation. The recombination energy was found from the ionisation energy plus the kinetic energies of the ions and electrons, which latter could be found from the current-voltage curves of a disc probe at the wall of the tube. The total radiation was measured by a thermopile, transmission corrections being determined by a photoelectric cell. The first doublet of the principal series at 8521 and 8944 Å. was found to contribute most of the radiation. The results obtained show that with low currents and pressures the radiation and recombination losses account for nearly the entire power input. With increasing currents and pressures there is an increasing balance of energy which is unaccounted for. All the energy terms change very slowly with pressure. The recombination loss is negligible at low currents, but becomes the most important factor at high currents. A. W.

4531. New Probe Method for Investigating Phenomena in Gas Discharges. J. Johannesson. *Ann. d. Physik,* 13. 8. *pp.* 953–966, *June* 20, 1932.—A special type of probe was used, consisting of a fine wire bent into a semicircle and suspended by a phosphor bronze torsion wire. A fibre of fused quartz stuck with shellac across the ends of the semicircular wire prevented deformation due to the weight of a thin glass rod attached below the wire and carrying a small mirror and damping arrangement. When properly suspended in a cylindrical discharge tube the semicircular probe lies entirely within an equipotential surface, and when charged to different potentials a rotation is observed proportional to the variation of the applied potential and to the field strength at the particular point of the discharge tube. A special electrometer with a sensitivity of 1 to 2 volts for a range of about 1000 volts was used for the measurements, and a description of this instrument is given. Results obtained by the new method are compared with results obtained by Langmuir's method. The two methods give close agreement, the results in general being higher than those obtained by the ordinary method. The behaviour of the potential along the whole length of the tube is shown to be given approximately correctly by the ordinary method, the values being all a little too low. With the new method evidence was obtained of a streaming in the gas from the kathode to the anode, which in the striated positive column varies rhythmically like the field strength but in the opposite sense. This effect is considered to be due to negative ions. A. W.

4532. New Method of Observing the Afterglow of Gas Discharges. L. Rohde and K. Schnetzler. *Zeits. f. techn. Physik,* 13. 8. *pp.* 358–363, 1932.—The optical lag of gas discharges is important in the use of neon lamps in television, etc. A lamp which could be filled with different gases was excited by one half cycle of a h.f. alternating potential and kept at zero p.d. for the other half cycle. The light emitted during the first half and the afterglow emitted during the second half were passed through a special form of Kerr cell which had three electrodes. By suitable arrangements the cell, which was supplied with an alternating potential of the same frequency as that used on the gas discharge tube, passed the afterglow through one side and the discharge through the other side. The duration of the afterglow was calculated from the transmitted intensity and was found to be of the order of 10^{-7} sec. in the negative glow and 10^{-6} sec. in the positive glow. The frequency used in television should therefore not exceed $10^5 \sim$. The duration of the afterglow increases with the gas pressure and is independent of the frequency. In ordinary h.f. alternating discharges, the striae are alternately luminous only in one half of the cycle, if there are an even number of striae, and this is attributed to oscillations of electrons between adjacent striae. J. E. R. C.

4533. Geiger-Müller Counter-Tube Experiments. J. N. Hummel. *Zeits. f. Physik,* 76. 7–8. *pp.* 483–504, *June* 20, 1932.—Experiments with a Geiger-Müller tube counter are described with particular reference to the various critical potentials associated with the tubes. The form of discharge and the effect of varying the electrical constants of the circuit are investigated. The effect of changing the direction of the applied field is studied and an explanation of the behaviour when using a negative potential on the case is offered. J. E. R. C.

4534. Absolute Values of the Mobility of Gaseous Ions in Pure Gases. N. E. Bradbury. *Phys. Rev.* 40. *pp.* 508–523, *May* 15, 1932.—The absolute method of measuring the mobilities of gaseous ions developed by Tyndall and Grindley was, with slight modifications, used to study the ionic mobility in gases of high purity. At time intervals of the order of 4×10^{-2} sec. only a single class of each ion was found for the positive and negative ion in air. The mobilities, 1·60 cm./sec. per volt/cm. for the positive ion and 2·21 cm./sec. per volt/cm. for the negative ion, are in agreement with other absolute values. Oxygen from $KMnO_4$ and from a commercial source carefully purified gave values of 1·58 for the positive and 2·18 for the negative ion. Nitrogen from a commercial source carefully purified gave no negative ions and a positive ion of mobility 2·09. Hydrogen gave no negative ions and a predominating positive ion of mobility 8·2. Indications of a higher mobility ion at 13·1 were also found. This is in agreement with the results of Loeb on Na^+ ions in H_2. Helium gave no negative ions and a positive ion of mobility 17·0. For pure gases and ion ages of the order of magnitude of those used (0·04 to 0·07 sec.) sharp peaks, indicative of a single class of ion, were always observed. A. W.

4535. Ionic Mobilities. M. Laporte. *Phys. Zeits.* 33. *pp.* 547–548, *July* 15, 1932.—Criticises in detail the objections to the author's method and results put forward by Stetter [see Abstract 3409 (1932)] to explain the differences between their results and shows that Stetter's objections are not well founded. A. W.

4536. Liberation of Electrons from a Negative Probe Electrode by Excited Atoms or Positive Ions. F. Lüdi. *Zeits. f. Physik,* 76. 5–6. *pp.* 319–321, *June* 7, 1932.—Additional evidence is brought forward bearing on the observation of Found and Langmuir [see Abstract 2080 (1932)] that the current to a negative probe electrode at different distances from the discharge in a neon arc discharge does not fall off as quickly as expected, because there is a secondary emission of electrons at the probe electrode, originating by collisions of the second kind from excited neon atoms. A precisely similar anomalously slow decrease of probe current with distance from the discharge was observed by Kobel working with a mercury arc discharge. W. S. S.

4537. Excitation Processes and Ionic Motion in the Electric Arc. R. Mannkopff. *Zeits. f. Physik,* 76. 5–6. *pp.* 396–406, *June* 7, 1932.—By spectral investigation of the light emitted by a d.c. arc before and after its interruption, the light excited by thermal vibration can be separated from the light excited by electron collisions. Thermal excitation is found to account for more than 0·75 of the total excitation. The strengthening of the atomic spectrum in a layer of about 1 to 2 mm. thickness in front of the kathode of a carbon arc is due to an increased density of the element in this region and not to increased excitation. The greater the degree of ionisation of an element, and hence its mean drift velocity in the field of the arc, the larger its vapour density will be in front of the kathode. Independently of the increase of density a further increase of the higher excited states occurs in a region limited to a distance of less than 0·05 mm. in front of the kathode. J. E. K.

4538. Recombination of Ions in Air at Low Pressures. E. Lenz. *Zeits. f. Physik*, 76. 9–10. *pp.* 660–678, *June* 27, 1932.—The coefficient of recombination of ions in air was determined for pressures from 20 to 760 mm. of mercury. The value of the coefficient was found to be very closely proportional to the pressure, with a normal value of $(1 \cdot 7 \pm 0 \cdot 1) \times 10^{-6}$ cm.^{2} sec.$^{-1}$ at 18° C. and 760 mm. pressure. The spacial distribution of the ions was measured and used in the calculation. The differences between the results now obtained and those of previous investigations are explained, so far as diffusion phenomena are concerned, by the neglect of the spacial non-homogeneity of the ionic distribution.

A. W.

4539. Ionisation of Benzene. E. Friedländer and H. Kallmann. *Zeits. f. phys. Chem.* 17. *Abt.B.* 4–5. *pp.* 265–275, *June*, 1932.—The ions resulting from the bombardment of benzene vapour by electrons of various velocities have been examined by the mass spectrograph. Twenty-five different kinds, ranging from C^+ to $C_6H_6^+$ are formed. Discussion of the mechanism of formation of the various ions indicates that $C_6H_6^+$, $C_6H_4^+$ and $C_2H_2^+$ are formed by direct impact, whereas C^+, C_2^+, CH^+ and others are produced by ionisation of decomposition products formed on the heated filament; in many cases the mode of formation cannot be stated definitely. The dissociation of $C_6H_6^+$ by impact with gas molecules is considered in detail.

H. F. G.

4540. Mass-Spectrograph Study of the Ionisation and Dissociation by Electron Impact of Benzene and Carbon Disulphide. E. G. Linder. *Phys. Rev.* 41. *pp.* 149–153, *July* 15, 1932.—C_6H_6 and CS_2 have been analysed by a mass-spectrograph designed especially for use with large molecules. In the case of benzene, ions have been found containing carbon in amounts from C_1 to C_6 with various amounts of hydrogen attached. The principal ion for electrons of 120 e-volts is $C_6H_6^+$. No negative ions and no H^+ ions were detected. Impacts of positive ions in the ionisation chamber detach H atoms from the carbon ring, but the carbon content of all observed ions seems to be unaffected by such collisions. The carbon-to-carbon bonds appear to be more stable than in the straight-chain hydrocarbons. CS_2 was used principally to calibrate the mass scale, and no extensive work done on it. At a pressure of $9 \cdot 7 \times 10^{-3}$ mm. Hg and impacts of 120 e-volts, the ions observed were CS_2^+, CS^+, S^+ and C^+.

AUTHOR.

4541. Ionisation of Argon and Neon by Neutral Argon Beams. O. Beeck. *Zeits. f. Physik*, 76. 11–12. *pp.* 799–801, *July* 12, 1932.—Kallmann and Rosen have shown that neutral rays of known velocity can be produced by neutralisation of an ion by means of an electron transference charge (*Umladung*). The author investigates the ionising action of these neutral argon rays in argon and neon. Preliminary results are given, showing the relative ionising efficiency of the neutral atoms, electrons and positive ions [see Abstract 3406 (1932)]. It is concluded that even when the neutral particle has but small energy it has considerable ionising power.

H. L. B.

4542. Law of Mutual Action of Ions. C. Putilov. *Zeits. f. Physik*, 76. 11–12. *pp.* 814–825, *July* 12, 1932.—The effective repulsive force between ions is shown to depend both upon the " architecture " of the electronic shell and upon their saturation with electrons. In the most general case of pairs of ions, in which the kations and anions have different ionic "architectures," the effective repulsion is shown to be proportional to the product of the numbers of electrons associated respectively with the kation and anion. J. S. G. T.

4543. Diffraction of Electrons. O. Specchia and S. Petralia. *N. Cimento*, 9. *pp*. 157–163, *June*, 1932.—A description is given of a simple arrangement by which the diffraction of electronic waves can be obtained. The results of experiments carried out with preparations of celluloid and of gold are discussed, and the various methods of obtaining diffraction fringes by means of electronic waves are considered. J. J. S.

4544. New Method for Investigating the Diffraction of Very Slow Electrons. A. Bühl. *Helv. Phys. Acta*, 5. 3. *pp*. 214–217, *June*, 1932.—In the case of electrons moving with velocities greater than those corresponding to about 10,000 volts, the diffraction patterns may be investigated photographically, but when the velocity is very small the photographic action is slight. The present paper describes a method of overcoming the difficulty by deflecting the diffracted electrons with a magnetic or electric field, and thus causing them to enter a Faraday chamber. The angles, etc., are calculable from the strength of the deflecting fields. G. E. B.

4545. Diffraction of Low-Speed Electrons by Single Crystals of Copper and Silver. H. E. Farnsworth. *Phys. Rev.* 40. *pp*. 684–712, *June* 1, 1932.—The diffraction beams for normal incidence on the (100) faces of copper and silver crystals are measured and the values of the associated refractive indices and inner potential are given. Silver crystals showed many maxima not given by theory. The intensity measurements on diffraction beams as function of angle of incidence disclosed that some beams increase in intensity whilst others decrease. A number of beams are due to "gas-lattices" on the surfaces of the crystals. These are separated out from those due to the crystals themselves. The inner potential is found to change discontinuously as the angle of incidence is varied. G. C. McV.

4546. Diffraction of Electrons by Single Crystals of Paraffins and Saturated Fatty Acids. J. J. Trillat and T. v. Hirsch. *Comptes Rendus*, 195. *pp*. 215–217, *July* 18, 1932.—This paper, after an introduction with respect to recent X-ray work on the structure and orientation of saturated fatty acids and paraffinic hydrocarbons, records experimental data on the diffraction of kathode rays by crystals of paraffin and of stearic acid. The thin films necessary were obtained by allowing a drop of an ethereal solution of the substance studied to evaporate on the surface of water, whereby all the crystals are orientated with their basal planes flat upon the water surface and the direction of the carbon chains perpendicular (paraffins) or oblique (fatty acids) to the base plane. An interpretation of the diagrams is included. H. H. Ho.

4547. Structure of Thin Films of Metallic Oxides. W. L. Bragg and J. A. Darbyshire. *Faraday Soc., Trans.* 28. *pp*. 522–529, *June*, 1932.—Narrow beams of electrons of 30,000- to 60,000-volt velocity are allowed to fall normally on thin films of the oxides of lead, zinc, and tin. Diffraction patterns are recorded on a photographic plate at a distance of 24 cm. from the film. Methods of preparing the oxide films are described.

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The results are summarised together with those obtained with the oxides of copper and nickel in earlier experiments. H. L. B.

4548. Structure of Thin Crystal Layers. F. Kirchner. *Zeits. f. Physik,* 76. 9–10. *pp.* 576–596, *June* 27, 1932.—The structure of thin crystal layers of about 20 different substances is investigated by electron interference methods. In nearly all cases the crystal particles are regularly orientated in a lattice structure with a definite net plane lying parallel to the underlying plane support. The theoretical interpretation of the lattice diagrams is very simple since the wave-length of the electron rays is small compared with the plane spacings. By slow evaporation of a thin layer *in vacuo* one observes a strong broadening of the interference rings, which is due to a colloidal state of the layer. Increase of layer thickness and decrease of the evaporation rate lead to an increase in the size of the layer particles. In certain crystals, *e.g.*, CdI_2, the transition from the colloidal state to the crystal state of complete orientation is observed to be a spontaneous one. J. E. K.

4549. Diffraction of Kathode Rays by Single Crystals. Part I. P-Patterns. K. Shinohara. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers* 368–369. *pp.* 223–236, *June,* 1932.—When a narrow beam of homogeneous kathode rays of the energy of 10–60 kV strikes a cleavage face of a crystal at a grazing angle, a diffraction pattern is obtained by placing a photographic plate behind the crystal. The pattern consists of pairs of black and white lines crossing the plate in various directions (called P-pattern), and sometimes also of spots similar to Laue's (called L-pattern). Photographs of P-patterns are here obtained by sending a beam of h.t. kathode rays against cleavage faces of calcite, rock-salt, zinc blende and mica. It is found that black and white lines become more and more diffuse as the spacing of the corresponding net-planes increases, and that the pair of such lines takes the appearance of a dark band when the spacing becomes quite large. This behaviour of the P-pattern is explained by the theory of Bethe. H. L. B.

4550. Inelastic Scattering of Kathode Rays. P. M. Morse. *Phys. Zeits.* 33. *pp.* 443–445, *June* 1, 1932.—A close analogy exists between the scattering of X-rays and of fast kathode rays. Elastic scattering of electrons can be compared with coherent X-ray scattering, and inelastic scattering of electrons with incoherent X-ray scattering. An expression has already been obtained for the sum of the two types of X-ray scattering, and a similar wave-mechanical calculation is carried out here for kathode rays. It is found that elastic electron scattering and coherent X-ray scattering show a similar angular distribution of intensity; maximum scattering in the direction of the primary ray decreasing as the angle between primary and secondary ray increases. Inelastic electron scattering and incoherent X-ray scattering behave differently, the latter having zero intensity in the direction of the primary ray which increases with the angle of scattering to a limiting value, whilst the former has its largest value in the primary ray direction and decreases as the angle of scattering increases. J. E. K.

4551. Scattering of Kathode Rays by Crystal Surfaces. F. Kirchner and H. Raether. *Phys. Zeits.* 33. *pp.* 510–513, *July* 1, 1932.—Under certain conditions when the incident radiation is almost parallel to the surface of the crystal, interference diagrams are obtained which are explained by the hypothesis that the surface net-planes of the crystal behave as a two-dimensional lattice. W. E. P.

4552. Focussing and Resolution of Kathode Rays in the Field of a Cylindrical Condenser. H. Voges. *Zeits. f. Physik*, 76. 5–6. *pp*. 390–394, *June* 7, 1932.—The paths of electron beams in the field of a cylindrical condenser are made visible by filling it with mercury vapour, and are photographed. The focussing of divergent beams of the same velocity and the maximum resolution of neighbouring velocities are shown to occur in the 127°17′ position predicted by theory. [See also Abstract 322 (1930).] C. B. A.

4553. Short Space-Charge Field of an Auxiliary Discharge as Concentration Lens for Kathode Rays. B. v. Borries and E. Ruska. *Zeits. f. Physik*, 76. 9–10. *pp*. 649–654, *June* 27, 1932.—Discussion of the concentration of a kathode beam by the positive space charge generated by the beam itself shows that by limiting the space charge to a part of the length of the beam a concentration effect can be obtained to a first approximation similar to that of an ordinary lens for a beam of light. In the arrangement actually used three co-axial rings were used and an auxiliary discharge passed between the central ring and the two outer ones. The effective focal length of this concentration lens could be varied by variation of the current strength of the auxiliary discharge. Good results were obtained with kathode rays of about 30 kV by using about 9 kV for the space-charge lens. An alternative arrangement using a specially designed grid is briefly described. Experiments with this will be described later. [See also Abstract 2557 (1932).] A. W.

4554. Relativistic Correction to Law of an Electromagnetic Concentration Coil for Kathode Rays. F. Ollendorff and G. Wendt. *Zeits. f. Physik*, 76. 9–10. *pp*. 655–659, *June* 27, 1932.—The quasi-optical behaviour of high-speed kathode rays in the field of a coil is discussed by analysis based on the equations of the special relativity theory. It is found that the correction factor to the motion found from Newtonian mechanics, given by consideration of relativity, may be quite appreciable for accelerating potentials of the order of those frequently applied in kathode-ray oscillographs. A. W.

4555. Angular Distribution of Electrons Scattered Elastically and Inelastically in Mercury Vapour. J. T. Tate and R. R. Palmer. *Phys. Rev.* 40. *pp*. 731–748, *June* 1, 1932.—A long electron gun was mounted to rotate about a well-shielded scattering region from which electrons scattered by gas molecules through a definite angle from a beam of small cross-section were collected, and their velocities determined, by a stationary collector containing an efficient Faraday cage, 6·0 cm. in length. Angular distribution curves for electrons scattered elastically, for electrons scattered due to excitation of the atom (mainly 6·7-volt energy loss), and for electrons resulting from ionising impacts are presented for 80, 120, 230, 490 and 700-volt electrons. In general, for a particular group, the curves are steeper the higher the velocity of the incident electron. The elastic group shows a diffraction pattern at large angles, and the positions of the peaks agree well with those found by Arnot. The curves for the excitation group are much steeper than are those for the elastic group, and fall to very small values at large angles. The curves for the ionisation group are also steeper, but not so steep as the excitation group; at large angles the scattering is due mainly to slow electrons of this group. The ionisation group is divided into sections, and further characteristics are observed. Numerical integration of these curves gives the cross-sectional area for collision, the efficiency of ionisation and the efficiency of excitation.

AUTHORS.

4556. Scattering of Electrons. H. Bethe. *Zeits. f. Physik,* 76. 5–6. *pp.* 293–299, *June* 7, 1932.—The loss of energy of electrons passing through matter is calculated. The loss per cm. of path is least when the velocity of the electrons is 96 % of that of light, and rises again for greater or lesser velocities.

G. C. McV.

4557. Elastic and Inelastic Electron Scattering in Hydrogen. A. L. Hughes and J. H. McMillen. *Phys. Rev.* 41. *pp.* 39–48, *July* 1, 1932.—An experimental study is made of the energy and angular distributions of electrons scattered by hydrogen. Elastic scattering is investigated in the range 40° to 165° for collision energies between 35 and 200 volts. The number of electrons scattered at any angle is smaller the greater the energy of impact. All curves show a minimum between 90° and 110°. Inelastic scattering is found to occur with energy losses ranging from a minimum of about 12 volts through a sharply defined most probable loss at 12·6 volts, to a complete loss of all energy. The probability of large energy loss increases with increasing energy of collision. The angular distribution of the electrons ejected from atoms in ionising collisions, and having various amounts of energy (1 to 8 volts), is studied for collision energies ranging from 35 to 340 volts.

J. E. K.

4558. Elastic Electron Scattering in Helium. A. L. Hughes, J. H. McMillen and G. M. Webb. *Phys. Rev.* 41. *pp.* 154–163, *July* 15, 1932.—The scattering of electrons by He atoms was measured experimentally over an angular range from 15° to 150° for electrons varying in speed from 25 to 700 volts. The scattering curves all fall steeply with angle, especially so for the smaller angles, provided that the speed is above 100 volts. For speeds below 100 volts, the steep fall at small angles is followed by a gentle rise beginning near 90°. Within the range cited, no maxima in the angular scattering curves were found. The theory of Mott accounted for the 700- and 500-volt curves accurately over the whole range, and for the 350-volt curve over the range 20° to 100°. Below 20° the experimental curve was steeper than the Mott curve, and above 100° the experimental curve was flatter than the Mott curve. As we go to lower energies, the departures from the Mott curves increase progressively. For small angles the theoretical curve is not steep enough, and for large angles it is too steep. The results were also compared with the theory developed by Massey and Mohr, taking into account certain factors omitted by Mott. While the newer theory accounts qualitatively for the upturn in the angular scattering curve, it fails to give its correct shape. It is shown how atomic structure factors, or F values, which are employed in the theory of X-ray scattering, can be inferred from these experiments in electron scattering.

AUTHORS.

4559. Electron Polarisation. G. O. Langstroth. *Roy. Soc., Proc.* 136. *pp.* 558–568, *June* 1, 1932.—The paper describes attempts to detect experimentally a polarisation of free electrons by a double-scattering method, using high-velocity electrons. The incident electron beam impinged at 45° on the first tungsten target and the specularly reflected

beam was directed to fall normally on the second tungsten target. The scattered intensities in the plane containing the initial incident and the specularly reflected beams, and at polar angles +90° and −90° with the normal to the second target, were measured. These intensities should differ if there is an appreciable effect due to electron polarisation. Asymmetries in the apparatus were eliminated by a differential method, in which the first tungsten target was rotated through 180°. The results showed that for primary electrons of energy up to 10 kV, the scattered intensities at +90° and −90° do not differ by more than the experimental error (1 %). The positive results obtained by other workers are summarised, and their connection with the specialised theory developed by Mott is briefly discussed.
W. S. S.

4560. Polarisation of Electrons by Scattering. E. G. Dymond. *Roy. Soc., Proc.* 136. *pp.* 638–651, *June* 1, 1932.—Mott has shown that scattered electrons may be expected to show some polarisation provided they are initially fast, that the scattering angles are large, and the scattering nuclei are heavy. The author, using electrons of up to 70 kV energy scattered from a gold leaf, investigates this polarisation by a scattering process. The orientation of the second scatterer (also gold leaf) was varied, and corresponding changes looked for in the electron beam. A full discussion is given of the possible errors and means adopted for their elimination are described. A positive effect was obtained (about 1·7 %), but is of a smaller order than that predicted by Mott. Substituting aluminium leaf as a scatterer removed all effects, and thus confirmed the view that the observed effect is a true one. The author points out that the existence of the effect is not incontrovertibly proved. An additional asymmetry, at right angles to the beam, is also possible. No explanation of this is forthcoming, and its reality is open to doubt. J. E. R. C.

4561. Polarisation of a Beam of Electrons by Crystal Reflection. J. Thibaud, J. J. Trillat and T. v. Hirsch. *J. de Physique et le Radium,* 3. *pp.* 314–319, *July,* 1932.—Literature relating to attempts to observe a polarised condition in a beam of electrons is briefly reviewed. Experiments by the authors, using thin gold or platinum foil as polariser and gold foil as analyser, gave negative results only, and the authors conclude that the production of polarisation in a beam of electrons by reflection at small Bragg angles is doubtful. J. S. G. T.

4562. Significance of the Ramsauer Effect in the Case of Symmetrical Diatomic Molecules. H. C. Stier. *Zeits. f. Physik,* 76, 7–8. *pp.* 439–470, *June* 20, 1932.—The Ramsauer effect has been interpreted as attributable to scattering of a plane wave in a medium of variable refractive index. It is pointed out that this interpretation is not generally applicable, and a theory of the effect employing wave mechanics based upon the postulation of the possibility of separating terms in the expression for the field of force, employing elliptic coordinates, is developed.
J. S. G. T.

4563. Depth of Origin of Photoelectrons. H. E. Ives and H. B. Briggs. *Phys. Rev.* 40. *pp.* 802–812, *June* 1, 1932.—Previous work [see Abstract 961 (1932)] has shown that the photoelectrons from a silver plate covered with an equilibrium film of alkali metal follow the wave-length distribution of energy just above the silver surface, *i.e.*, in the alkali metal. This question has been further investigated with particular references to alkali metal films in their early stages of development, where their average depth is less than one atom. Computations made on the absorption of light just within the silver surface show that there should be very definite and striking differences in the wave-length distribution of photoemission if emission occurs due to light absorption in the silver, as contrasted with emission from a film on the silver. Experimental tests made with sodium and cæsium films show that in the earliest measurable state the emission exhibits characteristics peculiar to the light absorption in silver, and that as the films build up the emission becomes characteristic of the energy above the silver. It is concluded that the photoelectrons originate partly in the underlying metal and partly in the alkali metal film, the relative proportions varying with the film thickness. AUTHORS.

4564. Photoelectric Currents in Gases between Parallel Plates as a Function of the P.D. N. E. Bradbury. *Phys. Rev.* 40. *pp.* 980–987, *June* 15, 1932.—If one of two parallel plate electrodes in a gas emits photoelectrons, the current received at the collecting electrode is a function of the p.d., the gas pressure, the initial velocity of the photoelectrons and the mobility of the carrier. In the experiments reported here, a quartz mercury arc and a plane zinc electrode were used as the source of photoelectrons. Current: p.d. curves were obtained for different gas pressures in hydrogen and nitrogen, and the ratio of the current, i, to the saturation current, I_0, obtained in each case. A theoretical equation of J. J. Thomson gives the relation $i = I_0(6\pi)^{\frac{1}{2}}kX/C + (6\pi)^{\frac{1}{2}}kX$, where X is the field strength; k the mobility of the carrier; and C, its random velocity. The validity of this equation is established by the experimental data which permit the values of the electron mobility k to be determined as a function of X/p. Values so obtained agree well with those obtained by Loeb and by Townsend and Bailey. An equation recently given by Langmuir [see Abstract 1376 (1932)] is shown to be applicable only at low pressures, where it yields a satisfactory value of the mean free path of the electron. AUTHOR.

4565. Photoelectric Properties of Films of Beryllium, Aluminium, Magnesium and Thallium. H. de Laszlo. *Phil. Mag.* 13. *pp.* 1171–1178, *June,* 1932.—The efficiency of photoelectric cells constructed of Be and Al is low; their spectral sensitivity is covered by that of Mg, which is more efficient. Tl, though very insensitive, is responsive to ultra-violet radiation only, and cuts off sharply at 3400 Å. Mg has an exceptionally high efficiency between 2800 Å. and 2400 Å., and can be used as far down as 4000 Å. Mg cells are easily constructed. Cells having any desired spectral sensitivity can possibly be constructed of Mg-Li alloys. J. S. G. T.

4566. Photoelectric and Thermoelectric Effects of Hydrogen-Charged Palladium-Silver and Palladium-Gold Alloys. J. Schniedermann. *Ann. d. Physik,* 13. 7. *pp.* 761–779, *June* 2, 1932.—The hydrogen absorption of palladium and its alloys with Ag and Au decreases linearly with the amount of the added Ag or Au. Photoelectric and thermoelectric effects are increased by the absorbed hydrogen, which raises the vapour pressure and the number of the free electrons in the interatomic space. They show a maximum in the alloys with 40 % Ag and Au, and thus run parallel whilst the curve of the H absorption takes another course. The Pd alloys saturated with H, which show a maximum of the photoelectric and thermoelectric effects, already exhibit the effects in the uncharged condition so that thus the H only produces a raising of the effects. The photoelectric and thermoelectric effects are surface effects. J. J. S.

4567. Photoelectric Effect in Fluids; Long Wave Limit for Water. P. Görlich. *Ann. d. Physik,* 13. 7. *pp.* 831–850, *June* 2, 1932. —Summarises previous work on the photoelectric effect shown by fluids and confirms Obolensky's and Counson and Molle's observation that water is photoelectric, and that the action is less in the case of concentrated solutions of NaCl, etc. The long wave-length limit for water and some aqueous solutions is determined. Light from a spark between suitable electrodes is passed through a fluorspar vacuum monochromator and allowed to fall on a cell of liquid in an evacuated chamber. Electrons ejected from the liquid are accelerated to a collecting electrode. The effect of gas pressure, etc., on the photoelectric current is investigated, and the long-wave limit for water is given as about 203 mμ. Small variations in conductivity have no effect upon this value. Concentrated aqueous solutions have the same long-wave limit. The photoelectric current from water per unit incident light energy has a maximum value at a wave-length 185 mμ, showing a strong absorption maximum for water at this wave-length. J. E. R. C.

4568. Photoelectric Action of Alkali Metal Surfaces. W. Kluge and E. Rupp. *Zeits. f. Physik,* 77. 1–2. *pp.* 82–99, *July* 19, 1932.— Examines the surfaces in an apparatus representing a photoelectric cell and a tube for exhibiting the diffraction of electrons, with a provision by which the surfaces can be brought to the temperature of liquid air. Electronic interferences were observed in the case of all the alkali metals, some very marked. E. E. F. d'A.

4569. Photoelectric Primary Current in Insulating Crystals. K. Hecht. *Zeits. f. Physik,* 77. 3–4. *pp.* 235–245, *July* 26, 1932.—Revision, in the light of more recent work, of Gudden and Pohl's results [see Abstract 2490 (1923)]. For the first time we have quantitative data as to the loss of electrons on the way to the anode. In cooled AgCl initially there wander only the electrons cleft off by light which retain a positive residual charge. The number of the electrons falls off on the way to the anode according to an exponential law, with a mean path of some millimetres. The mean path increases with the strength of the electric field in which the crystal lies, and is independent of the wave-length of the light which breaks off the electrons. The increase of the mean path with the field-strength leads to a saturation effect, even when the mean path is only a fraction of the thickness of the crystal. Data are given as to the amount of splitting off of electrons in pure AgCl and in AgCl with the addition of 0·05 % (molecular) of CuCl. A. D.

4570. Directions of Electrons Liberated by Ultra-Violet Polarised Light. A. Kraus. *Ann. d. Physik,* 14. 1. *pp.* 103–122, *July* 1, 1932. —On exposing potassium vapour to ultra-violet polarised light it is found that the intensity of electrons is a maximum in the direction of the electric vector, as expected according to theory. E. E. F. d'A.

4571. Resemblance between the Longitudinal Asymmetry of the Classical Field of an Electron, and the Distribution of Scattered Photoelectrons. L. Simons. *Phil. Mag.* 14. *pp.* 148–158, *July,* 1932. —Just as the energy of the field of an electron accelerated in the direction of its velocity alters its distribution with velocity, so the probability of emission of electrons under the action of light depends on the energy of the impinging photons. It is easily shown that there is a quantitative analogy between the two effects for low electron velocity, or low photon energy, and it is suggested, since the effects are more or less reciprocal ones, that the analogy should hold for higher values of these parameters. The consequences of this suggestion are found to be in good agreement with modern experimental results. In particular, theory and experiment now agree in showing that the forward momentum of a photoelectron is the same fraction of its total momentum as its velocity is of the velocity of light. J. H. A.

4572. Resistance Changes Produced by Magnetic Fields in Photoelectric Stop-Layer and Crystal Cells. E. Rupp. *Zeits. f. Physik*, 76. 9–10. *pp.* 597–607, *June* 27, 1932.—The photoelectric currents from Cu_2O stop-layer cells and from lead-glance single crystals decrease in magnetic fields proportionally with the square of the field strength. The decrease is smaller at −180° C. than at the room-temperature, and is greatest when the stop-layer surface is parallel to the field lines. In lead glance the photoelectrons were liberated in fractional amount preferentially in the plane of the photoelectric vector. The current decrease is independent of the wave-length of the incident light. By a comparison of the coefficient A of the resistance increase $\Delta W/W = AH^2$ of the photoelectronic with that of a conducted current, agreement within 10 % has been found. Photoelectrons and conduction electrons follow therefore the same mechanism. H. H. Ho.

4573. Lower Limit of Sensitivity in the Potassium Cell and its Adaptation to the Photoelectric Measurement of α-Preparations. G. A. Teves. *Ann. d. Physik*, 14. 1. *pp.* 57–79, *July* 1, 1932.—To measure very weak photoelectric currents produced by potassium cells, a more sensitive electrometer is used, and the dark current is reduced to 3 % of its value at ordinary temperatures by cooling the kathode with solid CO_2. With this experimental arrangement, ray intensities of 10^{-10} erg/cm. in the region 440–540 mμ are measured with an accuracy of 10 %, thus exceeding the sensitiveness of the human eye. The method is applied to the measurement of the emission of α-particles by radioactive substances, and it is found superior to the method of counting scintillations because the personal error and fatigue are eliminated. It is hoped to increase the sensitivity so that single α-particles or H-particles can be registered.
H. M. B.

4574. Selenium Blocking-Layer Cells. L. Bergmann. *Phys. Zeits.* 33. *pp.* 513–519, *July* 1, 1932.—The photoelectric current is proportional to the light so long as the external resistance is small compared with the internal resistance of the cell. The photo-e.m.f. approaches a saturation value with increasing illumination. With a sensitive surface of 9·7 cm. and an external resistance of about 2 ohms these cells give a current of 3×10^{-4} ampere without auxiliary e.m.f. The photo-e.m.f. is 0·2 volt per lumen. E. E. F. d'A.

4575. Caesium - Oxygen - Silver Photoelectric Cell. C. H. Prescott, Jr., and M. J. Kelly. *Bell System Techn. J.* 11. *pp.* 334–367, *July*, 1932.—The silver kathode is slightly oxidised by making it the kathode in a glow discharge of oxygen. Cæsium is then condensed on the surface. The active surface of the kathode appears to be a thin film of cæsium of atomic dimensions adsorbed upon a matrix of cæsium oxide and silver containing free cæsium and a small amount of silver oxide. The spectral characteristic of the photoelectric response appears to depend largely upon the thickness of the surface film of free cæsium. This film thickness is determined by the cæsium concentration in the underlying matrix, and is maintained by a diffusion equilibrium. E. E. F. d'A.

4576. Sources of Positive Thermo-Ions. Y. Takamura. *Phys. Math. Soc., Japan, Proc.* 14. *pp.* 292–296, *June*, 1932.—To find new sources of positive thermo-ions various samples were investigated. Among them, " barium carbonate and iron " gave a comparatively intense and practically constant emission of the positive ions at a constant temperature. There was a saturation voltage and a linear increase in the relation between the positive ion current and the applied voltage. The saturation voltage increased with the heating current of filament, and finally the saturation point became obscure. A formula,. $i = \mathrm{A}_1e^{-k_1t} + \mathrm{A}e_2{}^{-k_2t}$, is proposed for the decay with time of the positive ion current coming from a metal or a compound. AUTHOR.

4577. Evaporation of Ag, Be, Cr and Si. C. H. Cartwright. *Rev. Sci. Instruments,* 3. *pp.* 298–304, *June*, 1932.—Describes a procedure suitable for the evaporation of certain metals and the condensation of the vapour on glass or mica to produce mirrors, etc. Essentially the apparatus consists of a bell-jar, evacuated by a diffusion pump with a liquid-air trap, and containing a suitable tungsten heating coil. The metal, depending on its properties, is either put directly on the heater, or is contained in a suitable boat. Details are given of the cleaning processes necessary to produce good films, which in some cases can be stripped. G. E. B.

4578. Secondary Electron Emission from a Nickel Surface Produced by Positive Ions of Mercury. R. M. Chaudhri. *Cambridge Phil. Soc., Proc.* 28. *pp.* 349–355, *July* 30, 1932.—A beam of positive mercury ions, produced from an arc in mercury vapour, was passed through a narrow canal and caused to fall on a nickel surface. Adequate precautions were taken to prevent electrons produced at points other than the nickel surface from reaching the measuring galvanometers. Electrons were emitted from the nickel by this bombardment. It was found that the emission was considerably greater in the case of a dirty target than in the case of a clean, freshly degassed target, but even with a clean target the ratio of electron current to positive-ion current was about 2·3 % at 2000 electron volts. G. E. B.

4579. Discharges Maintained by Electrical Oscillations in Solenoids. G. D. Yarnold. *Phil. Mag.* 13. *pp.* 1179–1186, *June*, 1932.—Experiments were carried out to determine the relative importance of the electrostatic and electromagnetic forces of a solenoid forming part of an oscillating circuit in maintaining electrodeless discharges. In the first set of experiments alternate turns of the solenoid were connected to a set of equally spaced coaxial wire rings of the same diameter as the turns of the solenoid. These rings formed a cage in which the electric force was approximately the same as that in the solenoid, but in which the electromagnetic field was absent. The discharges were produced in a bulb 12 cm. diameter containing neon at about 1 mm. pressure. No discharge took place until the p.d. between the ends of the solenoid reached a certain value E_1, at which the discharge started suddenly. On decreasing the potential a minimum p.d. E_2 was found below which no discharge could be maintained. The values found with the bulb in the solenoid were $E_1 = 245$ and $E_2 = 118$ volts. With the bulb in the cage the values were $E_1 = 260$ and $E_2 = 125$ volts. In the second set of experiments the electrostatic force inside the solenoid was reduced by means of screens as in Lecher's experiments. Four screens were used, and with all except the smallest and most open one a p.d. of 2700 volts between the ends of the solenoid was insufficient to start a discharge in the bulb. With the fourth screen the discharge started at 2500 volts, and after starting could be maintained with p.d.s down to 860 volts. With the three other screens the discharge could be started by holding the bulb outside the screen and then bringing it inside the screen. The minimum p.d.s required to maintain the discharge were found to be 1250, 1160 and 960 volts, according to the size and closeness of the strips forming the screen. Further experiments showed that the discharge is partly due to the electromagnetic force in the solenoid. Measurements of the relative magnitude of the electrostatic and electromagnetic forces showed that the former is by far the greater. With no screen in the solenoid the ratio is of the order of 60 or more. The results show in general that electrodeless discharges are mainly due to the electrostatic field of the solenoid used when small discharge currents are in question. When, however, large discharge currents are obtained the electromagnetic force may become comparable with the electrostatic force. A. W.

4580. Dispersion of Polar Liquids for Radio-Frequencies. P. Girard and P. Abadie. *Comptes Rendus*, 195. *pp.* 119–121, *July* 11, *and pp.* 217–219, *July* 18, 1932.—By determining the absorption by Drude's method, Debye's equation connecting the statical and optical dielectric constants with ϵ' and ϵ'', the real and imaginary parts of the generalised dielectric constant, has been tested, the results being compared with calculated curves relating ϵ' and ϵ''/ϵ' at 20° to wave-lengths of 5–600 cm. for (the figures following each substance show respectively the viscosity, the radius $a \times 10^8$ in cm. of the molecule, assumed spherical, and the ratio of the volume of the molecule deduced from a to that deduced from the kinetic theory):—*n*-propyl alcohol, 0·025, 2·2, 1·5; *iso*-propyl alcohol, 0·025, 2·1, 1·9; *n*-butyl alcohol, 0·029, 2·5, 1·3; *iso*-butyl alcohol, 0·037, 2·5, 1·4; *n*-amyl alcohol, 0·040, 2·7, 1·3; *iso*-amyl alcohol, 0·046, 2·6, 1·4; *s*-dichlorohydrin, 0·085, 1·3, 16; *a*-dichlorohydrin, 0·12, 1·2, 18·5; glycol, 0·20, 0·60, 93; glycerol, 4, 0·36, 530. Results for ϵ' agree sufficiently with theory, but the ratio ϵ''/ϵ' is generally low. The disagreement between the volumes calculated by the two methods shows the necessity of taking into consideration the molecular configuration before the theory can be deemed satisfactory. [See Abstract 1979 (1929).] C. A. S.

4581. Debye Effect in Viscous Dielectrics. G. Todesco. *N. Cimento*, 9. *pp.* 125–131, *April*, 1932.—Experiments with wave-lengths of 90 to 40 m. have revealed, for castor oil, the existence of an absorption band in the range of Hertzian frequencies [see Abstract 1992 (1931)]. By further experiments with an oscillator giving wave-lengths down to 9 m., the position of the maximum of such absorption band is now determined as $\lambda = 21 \cdot 60$ m. (temperature 21°, viscosity 7·7 C.G.S. units). Application of a relationship derived from Debye's theory of polar molecules indicates for the radius of the castor oil molecule the value $1{\cdot}7\times 10^{-8}$ cm., which is in good agreement with that arrived at by other workers. T. H. P.

4582. Production of H.F. Currents by a Mercury Arc. B. D. H. Watters. *Brit. J. of Radiology*, 5. *pp.* 498–500; *Disc.*, 500, *June*, 1932.—By means of a sensitive receiver consisting of the usual detector with two stages of l.f. amplification, the nature of certain noises picked up by radio receivers when mercury arcs are struck was investigated. It is shown that the arc (of the vacuum type) emits h.f. oscillations, and that the crackling noises observed are probably due to a type of modulation caused by the condensation of mercury drops and similar disturbances. G. E. B.

4583. Ultra H.F. Oscillation of the Magnetostatic Valve. W. Dehlinger. *Physics*, 2. *pp.* 432–442, *June*, 1932.—A magnetostatic oscillator is defined as a generator of oscillations using a thermionic valve in combination with a constant magnetic field in such a way that the frequency is primarily determined by the anode voltage of the valve. The present paper, which is mathematical, is in three parts. Parts I and II discuss the flying time and falling angle of an electron in a cylindrical oscillator, assuming critical conditions and a steady plate current. Part III generalises these conceptions, and discusses the values of critical radius and the efficiency of the magnetron oscillator. G. E. B.

4584. Ultra-Short Electromagnetic Waves. Part III. Electronic Oscillations in Valves and Origin of Dwarf Waves. G. Potapenko. *Phys. Rev.* 40. *pp.* 988–1001, *June* 15, 1932.—The purpose of this paper is the elucidation of the causes of the generation of the dwarf waves, *i.e.*, of waves with frequencies exceeding many times the frequency of the oscillations of the electrons about the grid of the tube. The existing theories of the generation of ultra-short waves cannot give a satisfactory explanation of the origin of dwarf waves of different orders. This is due to the simplifying assumptions made by the theories in the conditions of the problem. The phenomena of generation of ultra-short waves are closely connected with the motion of electrons. Therefore, in order to obtain the explanation in question, an investigation was made of the motion of the electrons in valves generating ultra-short waves. The motion of the electrons was investigated graphically by means of special diagrams which simultaneously represented the trajectories of the electrons and the alternating potentials at the electrodes of the valve. In this manner it was shown that the reason a valve can generate dwarf waves is because it can transmit energy into the oscillating circuit coupled with it and transmit it periodically with a period equal to the natural period of the circuit not only when this period T is equal to the period of the electronic oscillations τ (normal waves), but also when $T = \tau/2$, $T = \tau/3$, $T = \tau/4$, . . . (dwarf waves). This property of the valve depends on the fact that in all the cases described a periodic division of the electrons into two groups is possible. According to the theory of E. Gill and J. Morrell this division determines the transmission of energy into the oscillating circuit. The above property of the valve means also that its dynamic resistance is negative under these conditions. The diagrams of the trajectories and the velocities of the electrons, constructed on the basis of the computations of G. Kreutzer, confirmed the above deductions. [See Abstract 2569 (1932) and following Abstract.] AUTHOR.

4585. Ultra-Short Electromagnetic Waves. Part IV. G. Potapenko. *Phys. Rev.* 41. *pp.* 216–230, *July* 15, 1932.—An investigation was made of the dependence of the wave-length of ultra-short waves on the filament current and on the amplitude of the oscillations. With the normal waves the wave-length increases as the filament current is decreased, but with the dwarf waves the wave-length decreases. At low filament currents the product $\lambda^2 E_g$ for dwarf waves of different orders is very close to the theoretical value given by $\lambda^2 E_g = \text{const.}/n^2$, where $n = 2, 3, 4, \ldots$ and the constant is the value of $\lambda^2 E_g$ for normal waves. The results obtained are in agreement with the theory of Epstein, which explains the discrepancy between the calculated and observed length of the normal and dwarf waves as due to the influence of the alternating potentials appearing on the electrodes during oscillations. In the limit, at infinitely low amplitudes of these potentials, the ratio of the values of $\lambda^2 E_g$ for normal and for dwarf waves approaches the theoretical value within the limits of experimental error. [See also Abstract 2569 (1932) and preceding Abstract.] A. W.

4586. Influence of Gases on Barkhausen Oscillations. H. Rindfleisch. *Ann. d. Physik,* 14. 3. *pp.* 273–298, *July* 20, 1932.—An investigation was made of the influence of gases, especially helium and neon, on Barkhausen oscillations. The valve employed had an electrode system identical in dimensions with that of the Schott K-valve often used for producing Barkhausen oscillations. The introduction of gases into the valve caused in all cases a change of oscillation intensity and an increase of wave-length. Investigation of the direct effect of the gas pressure gave an optimum energy in high vacuum, though pressures up to about 5×10^{-5} mm. of mercury gave no appreciable reduction. These results are of practical interest as affecting valve manufacture. With increasing pressure the starting point of the oscillations moved towards lower grid potentials, corresponding to the displacement of the saturation point of the emission curve. Increase of pressure beyond 5×10^{-4} mm. of mercury had in this respect no further effect. Increased pressure, besides causing a displacement of the intensity maximum towards lower grid potentials, gave a particularly well-marked reduction of energy in the region of higher potentials. In contrast with the behaviour of the rare gases, chemically active gases show very marked variations in the emission, which have a very pronounced effect on the behaviour of the valve. This result explains the observations of Nettleton, who found a sharp energy maximum at a pressure of 3×10^{-4} mm. The cause of the reduction of intensity with increased pressure is probably to be found in the impacts which occur between electrons and gas atoms, particularly in the space close to the hot filament. Little difference was found between the effects of the rare gases used. A. W.

4587. Production of Undamped Oscillations ($\lambda = 0{\cdot}1$ m.) by Back-Coupling. Part I. W. Kroebel. *Ann. d. Physik,* 14. 1. *pp.* 80–102, *July* 1, 1932.—The Barkhausen-Kurz method of producing ultra-short waves is mentioned, and the possibility of obtaining waves with a high anode potential as compared with the grid and kathode is introduced. For some time 31 cm. waves have been obtained by this method, and theory and experiment prove that this is not the limit of shortness of wave, but that there is every possibility of reducing it to a value of 0·1 m. or less. H. M. B.

4588. Simple Detector for Stationary Electric Waves. R. Ramshorn. *Phys. Zeits.* 33. *pp.* 451–453, *June* 1, 1932.—A linear resonator enclosed in a tube containing an inert gas is used to give a visible demonstration of the wave-length of electro-magnetic waves. A quenched spark transmitter gives waves of from 1–2 m., and of large enough amplitude of potential. A special parabolic-cylindrical grating-mirror is used to reflect the waves and make them stationary. Diagrams illustrate the type of apparatus and the results obtained. H. M. B.

4589. Radio Transmission Problems Treated by Phase Integral Methods. T. L. Eckersley. *Roy. Soc., Proc.* 136. *pp.* 499–527, *June* 1, 1932.—The transmission of electromagnetic waves in the space bounded by various conducting or ionically refracting surfaces or regions is considered; and in particular between plane or spherically stratified layers. Previously the author has shown how the main characteristics of the solution of such transmission problems can be obtained from a phase integral method analogous to that of Bohr and Sommerfeld [see Abstract **4306** (1931)]. In the present paper certain particular problems are treated, and a full-wave solution is obtained and compared with the solution derived by the phase integral method. The meaning and scope of this method are illustrated by the full solution of certain examples. Transmission between plane perfectly conducting layers is first considered, and then generalised to the case of imperfectly conducting layers. Finally, the method is applied to the case of diffraction of electromagnetic waves round a semi-conducting sphere. J. J. S.

4590. Synchronisation of Radio Stations. H. Abraham. *Comptes Rendus,* 195. *pp.* 116–118, *July* 11, 1932.—When a receiving station is set in feeble oscillation by a transmitting station, because of the coupling there are regions of synchronisation and non-synchronisation. The former maintain the oscillations over several periods, but the latter only act for a short time and produce the effect of beats. This gives a means of synchronising two stations without using special signals or modulations. H. M. B.

4591. Frequency Measurement with a Kathode-Ray Oscillograph. L. A. Wood. *Rev. Sci. Instruments,* 3. *pp.* 378–383, *July,* 1932. The author uses a kathode-ray oscillograph with a linear time-base to measure the frequency of electrical oscillations. The linear time-base mechanism comprises the usual diode, neon lamp and condenser, and by adjusting the filament temperature of the diode the flashing frequency can be varied. This frequency is adjusted until the electrical oscillations applied to the other pair of plates produce a stationary pattern upon the screen. The frequency to be measured is then a multiple or submultiple of the flashing frequency, and its order may be determined from the character of the pattern. The apparatus is calibrated with known frequencies, and the frequency to be measured can be inferred from the anode current of the diode. J. E. R. C.

4592. Magnetic Analysis of Internal Stresses. M. Kersten. *Zeits. f. Physik,* 76. 7–8. *pp.* 505–512, *June* 20, 1932.—The mean internal stress which remains in nickel wire that has been strained to the plastic state is calculated from the reversible work of magnetisation which can be obtained from the magnetisation curve. The magnitudes of the stresses thus found agree with those previously derived from the initial permeability. An estimate is made of the effect of internal stresses on the work done in magnetising single crystals. [See also Abstract 598 (1932).] G. E. A.

4593. Magnetic Properties of Magnetic Crystals at Low Temperature. C. H. Li. *Phys. Rev.* 40. *pp.* 1002–1014, *June* 15, 1932.—Thin circular discs cut parallel to the 100, 110 and 111 planes of magnetite crystals were prepared. The components of the intensity of magnetisation normal and parallel to the magnetic field at temperatures down to that of liquid air were investigated by the method of torsion. It was found that the magnetic properties of the crystal abruptly changed at about —160° C. This temperature corresponds exactly to the temperature at which the specific heat of magnetite increases suddenly to a maximum as was found by Millar two years ago. X-ray photographs taken at room-temperature and at liquid-air temperature show no difference, indicating that there is no change in the distribution of the points of diffraction. The intensity of the two patterns requires further measurements. Weiss' theory of the molecular field cannot be applied as −160° C. is not a Curie point. AUTHOR.

4594. Transformation of Magnetite at a Low Temperature. T. Okamura. *Tohoku Univ., Sci. Reports,* 21. *pp.* 231–241, *July,* 1932.—By means of various physical methods, such as, thermal analysis, electrical resistance, thermal expansion and the magnetic method, the author has studied an allotropic modification of natural magnetite at low temperatures. From the results of these measurements, the existence of an allotropic transformation of magnetite in the range of temperature −158° to −166° C. is confirmed. AUTHOR.

4595. Magnetic Properties of Thin Metal Coatings. W. Elenbaas. *Zeits. f. Physik,* 76. 11–12. *pp.* 829–848, *July* 12, 1932.—Layers of iron and nickel from 0·2 to 20 μ thick were deposited electrolytically and tested after their properties had become constant. In iron the coercive force increases as the thickness diminishes; the remanence also increases, but the magnitude of the change depends on the density of the current which deposited the layer. When the metal is heated at 600° in a vacuum for half an hour, the coercive force is reduced to about half its former value, but the remanence is diminished appreciably only in the case of the thicker layers. With nickel deposits, the permeability is not more than twelve, and the initial and hysteresis curves are rectilinear. The effect, on the coercive force, of heating in a vacuum is similar to that in iron. The remanence of the thicker layers is increased by the heating, but that of the thinner layers is much reduced. The heating also causes a change of direction of the axes of nickel crystals, but no change was observed in the iron. G. E. A.

4596. Ferromagnetic Moments of the Elements and the Periodic System. C. Sadron. *Ann. de Physique,* 17. *pp.* 371–452, *May–June,* 1932.—The paper records the results of research upon the variations of the absolute saturation of alloys of Ni and Co as a function of the proportion of added metal in the case of simple solid solutions. The properties of Ni/Mn and Co/Mn alloys indicate that the atom of Mn is orientated either parallel or anti-parallel to the ferromagnetic atoms which surround it. An atomic moment of 15·0 magnetons is therefore attributed to the Mn atom from experimental data. This hypothesis leads to a generalisation which allows the atomic moments of fifteen elements to be determined and the results, etc., are recorded in the present work. Cr, Mo, W, Pt, Pd, Ru, Sb, Si, Sn, Al, Zn, Cu and Au are thus treated. The values found constitute a homogeneous collection from which the following deductions are made: (1) For elements contained within the same column of the periodic classification the value of the atomic moment is the same, and (2) in the same line (*i.e.*, for iron) the moment varies linearly as a function of the atomic number. The allowance of variation for each additional electron is $+5{\cdot}25$ magnetons (Weiss) per additional electron from atomic number 19 to 23, and $-4{\cdot}0$ magnetons (Weiss) from 23 to 28. From K to V the augmentation of the moment for each electron added is compatible with the value of the Bohr magneton, whilst from V to Ni the decrease corresponds perfectly to a change of four magnetons as determined experimentally for each electron added. The last result is an important complement to the demonstration of the whole-number multiple of the moment of the Weiss magneton. S. G. B.

4597. Model of a Ferromagnetic Body Based upon the Theory of Weiss with Barkhausen Effect and Negative Permeability. K. Steimel. *Zeits. f. techn. Physik*, 13. 8. *pp.* 369–371, 1932.—The paper describes the design and lay-out of an apparatus for the investigation of the phenomena of the working of an external magnetic field upon a ferromagnetic body with the Barkhausen effect. It succeeds in establishing the cause of these phenomena and also in realising the previously only theoretically known negative permeability. Full details and description of experimental procedure are given. S. G. B.

4598. Ferromagnetism and Electrical Characteristics. Part V. Thermomagnetic Effect in a Longitudinal Magnetic Field. H. Broili. *Ann. d. Physik*, 14. 3. *pp.* 259–272, *July* 20, 1932.—A continuation of previous work [see Abstract 3001 (1932)]. The following ferromagnetic thermoelectric effect was investigated: Along the length of a ferromagnetic wire a temperature gradient or fall was established $T_2 - T_1$; parallel to the temperature fall a magnetic field H was established; an electromotive force E_m is thus created at the ends of the wire. The direction or sign of E_m is independent of the direction of the magnetic field. Its size or magnitude depends only upon the temperature difference $T_2 - T_1$, and not on the gradient dT/dl, and is also a function of the magnetisation, *i.e.*, the difference of magnetisation at the two temperatures. E_m does not alter further in value above the saturation value of the wire. The saturation values show that the wire possesses ferromagnetic hysteresis, and that above the Curie point it disappears. The maximum value of E_m exists when the temperature of half the wire is above the Curie point, and the other half is lower, *i.e.*, lies at the room-temperature, and is magnetically saturated. The sense and magnitude of E_m are given as: For Ni $\sim + 6 \times 10^{-5}$ volt, and for Fe $\sim - 4 \times 10^{-5}$ volt. The nomenclature for sign or direction is the same as that employed for thermoelements, namely, the cold end of Ni is positive. Iron shows the opposite direction and sign initially, but if recrystallisation creates an initial condition and temperature reversibility is reached, E_m shows a Villari point. S. G. B.

4599. Ionic Diamagnetic Susceptibilities. W. R. Angus. *Roy. Soc., Proc.* 136. *pp.* 569–578, *June* 1, 1932.—Following a review of the different methods for calculation of diamagnetic susceptibilities, the ionic or atomic susceptibilities of 76 atoms or ions having completed groups and sub-groups have been evaluated by Slater's method or a modification thereof. In the case of ionic susceptibilities of twenty-four ions with incomplete groups or sub-groups the values have been calculated by both Slater's method and the modification developed in the present work. The modified method gives results in concordance with experimental results. Criticism is made of methods of deduction of ionic susceptibilities from measurements of salts in solution or in the crystalline state. [See following Abstract.] S. G. B.

4600. Diamagnetic Susceptibilities of Beryllium Compounds. W. R. Angus and J. Farquharson. *Roy. Soc., Proc.* 136. *pp.* 579–584, *June* 1, 1932.—The susceptibilities for diamagnetism of basic beryllium acetate, propionate and pivalate, as also of beryllium acetylacetonate, have been measured, using a Curie–Chéneveau magnetic torsion balance by the method previously described by Farquharson. All measurements were made at 18° C. The results are given in tabular form, and, except for the oxide and basic carbonate, the agreement between calculated and experimental values is good. Angus' modification of Slater's method is used for the calculation of the ionic theoretical susceptibilities [see preceding Abstract], whilst for organic groups Pascal's data are used. Sugden's configurations using odd electron linkages are criticised in a discussion of the structure of organic derivatives. S. G. B.

4601. Magnetic Susceptibility of Sulphur Vapour. L. Néel. *Comptes Rendus*, 194. *pp.* 2035–2037, *June* 6, 1932.—The susceptibility was measured by the method of attraction in a non-homogeneous field, the sulphur being contained in a flask which forms the end of a pendulum. The results are considered to be only approximate, but values are given for various temperatures from 600° to 800° C., showing that the vapour is paramagnetic with susceptibility increasing rapidly with temperature. Thus the theory of van Vleck which is applicable to O_2 and NO is not applicable to S_2. J. E.

4602. Direct Measurement of the Magnetic Susceptibility of Liquids by the Curie–Chéneveau Magnetic Balance. C. Courty and C. Chéneveau. *Comptes Rendus*, 194. *pp.* 2197–2198, *June* 20, 1932. —The difficulty of subjecting equal volumes of liquid to the action of the magnetic field in the balance has been overcome by utilising tubes of special design blown in the shape of specific gravity bottles. The bulb portion of the bottle occupies the space between the magnetic poles. The same bottle is used to determine the density of the liquid used. The values for benzene, CCl_4, $CHCl_3$, absolute alcohol and pyridine are quoted as showing the extreme accuracy of the method as compared with other experimental results. S. G. B.

4603. Magnetic Susceptibility of Carbamides, Isocarbamides and Sulphamide. G. Devoto. *Accad. Lincei, Atti*, 15. *pp.* 973–976, *June* 19, 1932.—The results obtained with a number of these compounds confirm the very slight influence on diamagnetic properties exerted by the phenomena of isomerism, the fundamental factor in this respect being the chemical composition and not the chemical structure. Thus the values of $\chi_{\text{mol.}} \cdot 10^6$ are: for $NH_2 . CO . NHC_2H_5$, $-55{\cdot}5$; $NH_2 . C(:NH) . OC_2H_5$, $-54{\cdot}7$; $CH_3 . NH . CO . NH . CH_3$, $-56{\cdot}3$; and $NH_2 . CO . N(CH_3)_2$, $-55{\cdot}1$.

Values of the diamagnetism and density are given for a number of other compounds. T. H. P.

4604. Time-Disaccommodation of Small Symmetrical and Unsymmetrical Hysteresis Cycles. H. Atorf. *Zeits. f. Physik*, 76. 7–8. *pp.* 513–526, *June* 20, 1932.—Certain materials possess, immediately after demagnetisation, higher reversible and initial permeability than they have at a later period. The effect is called time-disaccommodation, and it is observed in ferromagnetic materials which contain silicon. The effect is ascribed to a time-change in internal stress; it is present in material which has undergone mechanical or magnetic treatment, and it depends probably on the atomic structure of the crystal lattice. The effect is employed to explain the observed displacement of small hysteresis cycles. G. E. A.

4605. Eddy Current Retardation in Magnetic Circuits. W. Wolman and H. Kaden. *Zeits. f. techn. Physik*, 13. 7. *pp.* 330–335, 1932.—The rise of the magnetic flux of force in iron sheets after sudden switching-on of the external magnetic field is dealt with. For the case of constant permeability a time-constant can be given which forms a measure of the duration of the process. Between this time-constant and the limiting frequency defined for the stationary alternating field there exists a simple linear relation. The case of strongly variable permeability is treated as penetration of a steep induction wave-front from the edges to the interior of the iron. J. J. S.

4606. Positive Elongation in the Joule Magnetostrictive Effect in Nickel. S. R. Williams. *Phys. Rev.* 41. *pp.* 251–253, *July* 15, 1932.—The question as to whether there is a positive Joule magnetostrictive effect in nickel has once more arisen. The following note points out that there is no positive elongation unless remanent magnetism or an extraneous field is present to give the sample of nickel a preliminary magnetisation before the main field is applied. Even then, there is no positive elongation unless the preliminary magnetisation is opposed to that of the main field. AUTHOR.

4607. Recording Micro-Dilatometer and Thermo-Magnetometer. P. Chevenard. *J. de Physique et le Radium*, 3. *pp.* 264–280, *June*, 1932.—A recording micro-dilatometer is described for plotting directly minute isothermal expansions and contractions of specimens, *e.g.*, invar, steels, as a function of the logarithm of the time. A recording thermo-magnetometer, insensible to changes of the earth's magnetic field, designed for investigating minute changes in the magnetic properties of materials due to temperature is described. J. S. G. T.

4608. Thermoremanence and Spontaneous Magnetisation. J. Koenigsberger. *Phys. Zeits.* 33. *pp.* 468–474, *June* 15, 1932.—The more closely such ferromagnetic materials as show hysteresis are heated to the Curie point, the weaker may be the effective magnetic field during cooling, to give a definite value to the remanent magnetisation which may be latent near the ferromagnetic Curie point. This remanence increases with decreasing temperature in the external null field. In a field of strength 0·41 Oe., synthetically produced polycrystalline magnetite (Fe_3O_4) exhibits a thermoremanence of approximately one-eighth of the saturation remanence and one-fortieth of the inductive saturation. The thermoremanence,

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for weak fields in the neighbourhood of 0·4 Oe., increases to a first approximation, almost linearly with the field. For single crystals such as haematite (Fe_2O_3) for fields of 0·4 Oe., the thermoremanence in the direction perpendicular to the principal axis, is about 0·70 to 0·95 of the saturation remanence and about one-half of the inductive saturation magnetisation. The thermoremanence is strongly evident at temperatures where the Curie point comes close to about 30° C. Steel and kinds of iron where strong coercive forces exist also show thermoremanence but much weaker than the crystalline substances above mentioned. In the case of electrolytic iron the thermoremanence was not discernible. The influence of the form factors of demagnetisation and their connection with the thermoremanence of magnetite is established in the discussion, which also includes the connections between theory and results of the present work and those of Weiss, Forrer, Heisenberg, Bloch and Becker. S. G. B.

4609. Possible Thermal Effect Accompanying Sudden Magneton Number Changes in $CuCl_2$ and $NiSO_4,7H_2O$. D. S. Kothari. *Cambridge Phil. Soc., Proc.* 28. *pp.* 338–340, *July* 30, 1932.—It is known that there are sudden changes in the $1/\psi$, T, curves for some salts and it is suggested that these correspond to sudden changes of magneton number. Calculation shows that easily detectable temperature changes might reasonably be expected to accompany these changes and the author describes experiments designed to investigate this point. No temperature change as great as 0·1° C. was observed and it is deduced that either the change is not sudden or else the separation between the two energy states is much smaller than is probable. J. E. R. C.

4610. Measurement of the Einstein–de Haas Effect. F. Coeterier and P. Scherrer. *Helv. Phys. Acta,* 5. 3. *pp.* 217–223, *June,* 1932.—Describes a method of determining the *g*-factor of substances, in which the difficulties of working with small damping are reduced. A small bar of the substance is suspended on a quartz fibre in a vacuum; the fibre carries a mirror which, in the zero position, reflects a beam of light through a slit into a photoelectric cell. The cell operates a relay, which reverses the magnetic field when the cell is illuminated. In this way perfect synchronism of the reversed field and vibration of the test specimen is attained. In the case of iron, *g* was found to be 2·01. G. E. B.

4611. Current Field in a Circular Plate. H. Ataka. *Phil. Mag.* 14. *pp.* 142–147, *July,* 1932.—The distribution of current in a circular disc is calculated when a circular electrode is placed in it, with a second electrode along a part of the circumference. The method is that of conformal representation. The effective resistance in various cases is also calculated numerically. J. H. A.

4612. Operational Calculus. Part I. The Definition of an Operational Representation of a Function and Some Properties of the Operator Derived from this Definition. Part II. The Values of Certain Integrals and the Relationships Between Various Polynomials and Series Obtained by Operational Methods. H. V. Lowry. *Phil. Mag.* 13. *pp.* 1033–1048, *May, and pp.* 1144–1163, *June,* 1932.—Part I. Fundamental points in the theory of operational calculus are discussed. In particular, it is shown that there are good reasons for preferring the definition of an operational representation of a function by

Bromwich's contour integral to the definition of Carson's integral. Fundamental properties of an operational representation of a function are derived from this definition. Part II. Operational methods are applied (1) to find the values of certain integrals, (2) to establish relationships between Bernouilli and similar types of polynomials, (3) to sum Bessel-function series of the type $\sum_{r=1}^{\infty} r^{-1/2} J_n(2\sqrt{rx})$, (4) to sum Bessel functions of the Schlömilch type, *e.g.*, $\sum_{m=1}^{\infty} J_n(mx)$, $\sum_{m=1}^{\infty} J_n(mx)/m$, (5) to sum series of the type $\sum_{m=1}^{\infty} J_n(mx) \cos my$, and (6) to sum series of Struve functions corresponding to (4) and (5). J. S. G. T.

4613. Generalised Division and Heaviside Operators. A. Press. *Phil. Mag.* 14. *pp.* 78–86, *July*, 1932.—Algebraic expansions of $1/(D - a)$, where $D = d/dx$, have been suggested by Heaviside and by Forsyth. The author employs another mode of expansion based upon the identity $o/(a - x) = a_m x^m\{1 + (x/a) + (x^2/a^2) + \ldots\} - a \,.\, a_m x^m/(a - x)$. The last expression corresponds to a " persistency term " on which the degree of approximation of the solution of the differential equation depends. The method does not employ fractional differentiation, and substantiates Heaviside's preference for his treatment of " divergent " forms. The types of solution obtained conform mainly to those suggested by Heaviside having a two-way-series form. The theory is applied to the discussion of Heaviside's generalised exponential and generalised Bessel functions.
J. S. G. T.

4614. New System of Units in Electromagnetism. J. E. Verschaffelt. *J. de Physique et le Radium*, 3. *pp.* 225–228, *June*, 1932.—In reply to an invitation of the Union Internationale de Physique, for suggestions for a new system of units in electromagnetism, the author proposes to adopt as a new fundamental unit a conventionally chosen unit of electric charge equal to 10^{-4} of the charge carried by a gm.-ion of hydrogen. This would give five fundamental units—length, mass, time, temperature and electric charge. The dimensional units of the various electromagnetic magnitudes are worked out in the new system. The dielectric constant in free space has a value different from unity in this system. W. S. S.

APPARATUS AND INSTRUMENTS.

4615. International Comparison of Electrical Standards. G. W. Vinal. *Bureau of Standards, J. of Research*, 8. *pp.* 729–749, *June*, 1932.—Extended comparisons were made in 1931 of standards for the international ohm, ampere and volt as maintained by the national laboratories of Germany, England and the United States. Joint experiments were made with the silver voltameter and standard cells and resistances were compared. This work was followed by comparisons of the cells and resistances at the Laboratoire Central d'Électricité in Paris and at the National Physical Laboratory in Teddington. This paper gives in detail the results of these comparisons and shows that there are differences in the values of standard cells and resistances which are large enough to suggest the necessity for a readjustment of the units as maintained by the laboratories. The silver voltameter measurements were in good agreement. AUTHOR.

4616. Nernst Bridge of High Precision. Jacqueline Hadamard. *Comptes Rendus*, 194. *pp*. 1799–1801, *May* 23, 1932.—Discusses the general accuracy of measurement with a Nernst bridge of high quality using a three-stage amplifier. It is concluded that, with air as dielectric in the test condenser, a mechanical reproducibility of $0 \cdot 5 \times 10^{-2}$ e.s.u. is attainable, and that this figure represents about the practical limit of accuracy. Assuming the condenser to have a volume of 40 c.c. this represents a precision of 1 part in 4000 or more in measuring dielectric constants.
G. E. B.

4617. A.C. Wheatstone Bridge for Audio- and Radio-Frequency Measurements. A. Hemingway and J. F. McClendon. *Physics*, 2. *pp*. 396–402, *May*, 1932.—The bridge contains in its four arms two equal ratio resistances, the unknown resistance and a balancing arrangement consisting of two decade resistances and a decade capacity. For audio-frequency measurements, a Vreeland oscillator is used as a source of a.c. and balance is made by ear-phones. For h.f. measurements, a heterodyne method is used, the beat-note between the main oscillator and a heterodyne oscillator being used for detection. Full details of the components, method of mounting, shielding and earthing are given in the paper. Audio-frequency measurements have an accuracy of about 0·1 %, and radio frequency measurements about 1 %. G. E. B.

4618. Refinement of the Bridge Method for the Measurement of the H.F. Resistance of Electrolytes. W. Geyer. *Ann. d. Physik*, 14. 3. *pp*. 299–320, *July* 20, 1932.—Very full details are given of a modified bridge method in which the error is of the order of only 0·02 %. Heating of the electrolyte is obviated by passing only minimum current, the induced current, which is fed to a loud-speaker, being amplified considerably. The change of conductivity with frequency has been studied in the case of NaCl and $MgSO_4$ solutions for a range of wave-lengths between 39 and 185 m.; the results are in good agreement with the Debye theory.
H. F. G.

4619. Valve-Bridge Theory and a New Compensated Valve-Voltmeter. A. S. McFarlane. *Phil. Mag*. 14. *pp*. 1–18, *July*, 1932.—The general theoretical relationships which hold in a Wheatstone bridge system, two of whose arms consist of triode valves, are considered and an expression is deduced, and experimentally verified, for the condition that the bridge may be simultaneously balanced and compensated against fluctuations in the supply. The theory is given of a new device whereby the filament and grid voltages are derived from the 4-volt battery in such a way that minor changes in voltage of this battery have no significant effect on the bridge zero. A robust practical form of valve-voltmeter is described which is compensated against changes of 20 volts in the supply and 0·3 volt in the common grid l.t. supply, and a simple empirical procedure is given for adjusting the compensation device. H. H. Ho.

4620. Electronic Devices as Aids to Research. A. W. Hull. *Physics*, 2. *pp*. 409–431, *June*, 1932.—A review of some modern applications of thermionic devices to research. Among the uses mentioned are the application of photoelectric cells of modern type to the problems of photometry and colour measurement, the uses of highly insulated and well evacuated triodes for the measurement of small voltages, and hence of resistance, etc., and various uses of thyratrons, including the cascade relay used for counting α-particles. G. E. B.

4621. Low Noise Valve. G. F. Metcalf and T. M. Dickinson. *Physics*, 3. *pp.* 11–17, *July*, 1932.—When commercial valves are used to amplify small l.f. voltages it is found that random disturbances of the order of 100 to 1000 μV are present in the anode circuit. These disturbances exist almost entirely in the range below 100 ∼, and therefore fix the minimum voltage which can be measured over this l.f. band from 10 to 100 μV. These disturbances are shown to be caused by any or all of the following: (1) insulating material in or near electron path; (2) irregularity of filament emission; (3) gas; (4) positive ions emitted by filament; (5) insulating or foreign deposits on grid wires. A valve has been developed in which the above effects are removed or reduced to a point where the disturbances are nearly that of the shot effect of the electrons, as limited by space charge. This allows the amplification of low-frequency voltages of less than 1 μV over the entire frequency band below 100 ∼. AUTHORS.

4622. Thermionic Voltmeter. J. Thomson. *Journ. Sci. Instruments*, 9. *pp.* 186–191, *June*, 1932.—The paper describes a thermionic voltmeter the action of which depends upon the emission of secondary electrons from the anode of a new type of valve. The capacity of the instruments and its power factor are exceedingly small, so that it is very suitable for the measurement of high potentials at high frequencies. [See also Abstract 1405 (1932).] AUTHOR.

4623. Projection Galvanometer. R. H. Howe. *Rev. Sci. Instruments*, 3. *pp.* 323–327, *June*, 1932.—Describes a modification of a galvanometer to make possible projection on a lantern screen. A suitable instrument (of the d'Arsonval type) is mounted in a frame which can replace the slide carrier of the lantern, the instrument case being removed and replaced by glass plates, one of which carries a suitable scale. By careful construction, the pointer and scale can be placed sufficiently close together for the two to be in focus together. It is stated that the projector can be used in most cases in a reasonably light room, and that no special screen is required. G. E. B.

4624. Switch for Elimination of Parasitic E.M.F. W. P. White. *Zeits. Instrumentenk.* 52. *pp.* 281–284, *June*, 1932.—The author points out certain defects in the switch devised by Ebert and Lange for the elimination of parasitic e.m.f.s [see Abstract 3601 (1931)] and suggests some modifications and improvements. He discusses his experience in the use of various switches and methods of suppressing disturbing e.m.f.s. J. J. S.

4625. Electrostatic Alternator. C. A. Culver. *Physics*, 2. *pp.* 448–456, *June*, 1932.—In electrical measurements and research work it is frequently necessary to have available a source of e.m.f. having a sine wave form. It is also desirable to be able to produce electrical wave forms having special contours. Existing means for producing special e.m.f. wave forms have serious limitations. By utilising a continuously varying capacitance, means are developed whereby a pure sine wave, as well as special forms, may be produced. Filtering is not required. The theory underlying the production of any desired wave form is outlined. Factors which tend to modify the resultant wave form are pointed out. AUTHOR.

4626. Vibrating-Reed Oscillograph. F. J. Shollenberger. *Rev. Sci. Instruments*, 3. *pp.* 365–366, *July*, 1932.—This instrument consists of a vibrating system of essentially the same nature as that used in a loudspeaker of the moving-coil type. The coil is wound on a paper former, and hangs in the air-gap (about 1/16 in. wide) of the magnet, its upper end being connected to a reed supported on jewelled bearings. A mirror is supported on the reed. G. E. B.

4627. Mechanically Controlled Bolometer. H. Sell. *Zeits. f. techn. Physik*, 13. 7. *pp.* 320–327, 1932.—A method is described by which it is possible with feeble continuous currents, such as those produced by thermoelements, both to liberate relay actions and also to reinforce the currents quantitatively. The method depends on this, that by indicating instruments, preferably turning coil instruments, air currents are controlled which act on a bolometer arrangement. Very small mechanical movements are transformed into oscillations of electric current. J. J. S.

4628. H.T. Condensers. H. Wommelsdorf. *Zeits. f. techn. Physik*. 13. 7. *pp.* 328–330, 1932.—H.t. condensers of a new form are described which consist of glass tubes containing a rarefied gas such as argon or neon, and which from various points of view are preferable to Leyden jars. J. J. S.

4629. New Magnetometer. C. A. Helland. *Physics*, 3. *pp.* 18–22, *July*, 1932.—A vertical magnetometer is described which is believed to fill the need for an intermediate type between the dip needle and the Schmidt balance. It does not require a tripod and levels itself. The compass for orientating remains attached to the instrument; it may also readily be compensated for temperature. It utilises a magnetic system suspended in jewels in or near its centre of gravity; the magnetic vertical intensity is balanced by the torsion of a helical spring. The magnetic system is adjusted to the normal vertical intensity in the area under survey by a suitable setting of the spring and the anomaly is roughly proportional to the angle of deflection from the horizontal. AUTHOR.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

4630. Interpretation of Spectrograms. A. H. Taylor and T. Knowles. *J.O.S.A*, 22. *pp.* 229–235, *April*, 1932.—A discussion of the precautions necessary in the interpretation of spectrograms, particularly those obtained in investigating the transmission of materials employed in therapeutic work. A. H.

4631. Diathermy Protective Devices. Use of the "Contactometer" or Contact Gauge. G. G. Blake. *El. Rev.* 110. *pp.* 701–702, *May* 13, 1932.—During the administration of diathermic treatment, particularly to the eye and internal parts of the body, patients occasionally receive burns due to bad contact of the electrodes. The author has shown that, when asymmetrical electrodes are used and good contact is present, the smaller electrode is always negative to the larger. As contact is reduced rectification is also reduced, until sparking and burning of the patient occurs at the smaller electrode. By utilisation of this rectified current, the author has devised a "contactometer" which is intended automatically to stop the treatment when danger of burning occurs. This apparatus is described and illustrated in detail. B. J. L.

4632. Medical Application of Radioactive Emanations. d'Arsonval. *Comptes Rendus*, 194. *pp.* 2101–2102, *June* 13, 1932.—Emphasises the importance of having available for therapeutic purposes

simple methods of using radon, and refers to the work of G. Vaugeois, who devised in 1926 suitable solid media on to which radon could be adsorbed, and from which it could be released if necessary for use.
W. V. M.

4633. Radiosensitiveness of Cells and Tissues and Some Medical Implications. A. U. Desjardins. *Science,* 75. *pp.* 569–575, *June* 3, 1932.—The author discusses the action of X-ray and radium energy upon living tissue. The general laws of such action and the particular effects upon special tissues are discussed in detail, but the discussion is histobiological rather than electrical and reference should be made to the original paper, which is of definite value. B. J. L.

4634. Action of Ultrasonic Waves on Isolated Cells in Suspension. E. Biancani, H. Biancani and A. Dognon. *Comptes Rendus,* 194. *pp.* 2168–2170, *June* 13, 1932.—Preliminary results of experiments on paramœcia and red blood cells under the action of h.f. vibrations. The apparatus generates waves of 250 kc. and approximately 0·5 kVA (70 mA at 7 kV), the crystal being 7 cm. dia. and 1 cm. thick. The suspensions of cells have been studied under four conditions, (1) the experimental tube plunged in the vibrating bath; (2) in capillary tubes (less than 3 mm. dia.); (3) in drops set in vibration by a glass rod whose one end is in the drop and the other in the vibrating bath; and (4) the drop directly placed on the vibrating quartz. Complete cellular destruction is rapidly obtained, the phenomena depending on the concentration of cells, a sharp threshold being observed. In a capillary tube the phenomena are different, stationary waves being produced. The destruction of cells is also rapidly affected, by the pressure on the surface of the liquid, an excess pressure of 0·5 to 1·0 atmosphere preventing all action. The effects produced in a drop on the quartz oscillator are very intense, the cellular destruction being explosive in violence; the production of vibrations of the paramœcia themselves is essentially dependent on the form or the volume of the drop, its effect appearing to be purely mechanical. W. V. M.

4635. Kipp Apparatus for Electrical Nerve-Excitation. H. König. *Helv. Phys. Acta,* 5. 3. *pp.* 212–214, *June,* 1932.—Describes an electrical circuit suitable for investigating the problem of nerve-stimulus produced by a single electrical impulse. An impulse circuit of triodes is connected to the nerve, and also to the deflecting plates of a kathode-ray oscillograph, while a pair of contacts from the nerve lead to an amplifier and hence to the oscillograph. The p.d. between the contacts is of the order of a few millivolts, and the time involved is of the order of say 10^{-3} sec. Particular care must be taken that the amplifier responds sufficiently quickly to the transient, and details of a suitable type are given. G. E. B.

4636. Radiological Apparatus Exhibited at the Third International Congress of Radiology. H. Pilon. *Soc. Franç. Elect., Bull.* 2. *pp.* 673–687, *July,* 1932.—A description of the exhibits, mainly from the point of view of the advances made since the Second Congress. The survey covers X-ray tubes, including oil-immersed tubes, h.t. generators, couches, etc., used for X-ray work, and also some new diathermy apparatus, which incorporates oscillating triodes instead of spark oscillators.
G. E. B.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

4637. Clean-Up of Hydrogen in the Presence of Potassium or Lithium Ion Sources. C. H. Kunsman and R. A. Nelson. *Phys. Rev.* 40. *pp.* 936–939, *June* 15, 1932.—The rate of clean-up of hydrogen was observed on potassium and spodumene glass surfaces, sources of K and Li ions respectively. Although there has been considerable difference of opinion as to the nature of this disappearance of hydrogen, *i.e.*, whether it is a surface or gas phase reaction, our results show that the entire effect can be accounted for by a reaction on or within the hot glass, very likely the formation of water vapour. AUTHORS.

4638. Thermal Activation Effect in the Adsorption of Hydrogen on Platinum and Nickel. E. B. Maxted and N. Hassid. *Chem. Soc., J. pp.* 1532–1539, *May*, 1932.—The amount of H_2 adsorbed by Pt or Ni at a given temperature may be much increased if the metal is heated in the gas to a higher temperature than that at which adsorption is taking place and then allowed to cool in it. The amount of H_2 adsorbed at a given temperature is dependent upon the temperature at which this activation process was carried out. Moreover the activation is approximately additive in the sense that the additional adsorption caused by heating and cooling through a given range is approximately equal to the sum of the values observed if the heating and cooling are carried out in successive small stages in place of in one step. This thermal activation effect is explained by assuming that the adsorbing surface is energetically heterogeneous. [See Abstracts 1773 and 3468 (1932).] F. J. W.

4639. Active Charcoal. Part I. Adsorption Isotherms of Organic Acids on Ash-Free Charcoals. C. Ockrent. *Chem. Soc., J. pp.* 1864–1875, *June*, 1932.—The adsorption isotherms of formic, acetic, monochloracetic, trichloracetic, salicylic and benzoic acids in aqueous solution have been determined at 25° on three different ash-free sugar charcoals. All the isotherms satisfied the Langmuir equation. From the constants of the equation it is found that the rate of condensation and evaporation of a given acid on each of the charcoals was the same. The charcoals differed only in their available areas. The available surface area for a given charcoal is determined by the size of the adsorbed molecules. F. J. W.

4640. Quantum Mechanics of Activated Adsorption. A. Sherman and H. Eyring. *Am. Chem. Soc., J.* 54. *pp.* 2661–2675, *July*, 1932. —It is shown that in general the velocity of a bimolecular surface reaction will pass through a maximum at a certain temperature. The calculated activation energies of the hydrogenation of ethylene and acetylene, and of the activated adsorption of hydrogen on carbon, are about 9 % too high, and the significance of this result is discussed. The activation energy of the adsorption of hydrogen on carbon falls to a minimum as the distance between the surface carbon atoms increases to 3·6 Å., and thereafter rises again. Various possible mechanisms of the catalytic conversion of para- to ortho-hydrogen are discussed. A solution is given of the problem of spin degeneracy of six electrons, and the equation for the potential energy is applied to the calculation of activation energies. H. F. G.

4641. Sorption Velocity of Gas by a Porous Solid. J. Sameshima. *Chem. Soc. Japan, Bull.* 7. *pp.* 177–188, *June*, 1932.—A summarising paper. F. J. W.

4642. Adsorption of Radon by Silica Gel in Relation to the Water Content of the Gel. M. Francis. *Kolloid Zeits.* 59. *pp.* 292–298, *June*, 1932.—The influence of the water content of technical samples of silica gel on the amount of radon which it adsorbs has been studied. Two maxima are obtained with gels containing water contents between 1·2 and 5·5 %. These maxima correspond with structural changes in the gel. F. J. W.

4643. Analysis of the Adsorption Phenomena with Silica Gel at Low Temperatures. W. D. Urry. *J. phys. Chem.* 36. *pp.* 1831–1845, *June*, 1932.—The adsorption of He, A, O_2 and CH_4 on the same sample of silica gel has been studied at temperatures between 90° and 273° K. A discontinuity of the adsorption phenomena has been observed at a definite temperature (about 38° above the critical temperature). Above this temperature the adsorbed volume is proportional to the pressure and the adsorption is accompanied either by an increase in the effective surface or an increase, proportional to the pressure, of the fraction of the effective area occupied by the gas molecules. The temperature coefficient of adsorption in this region is small. Below the temperature of discontinuity, which is considered to be close to the critical temperature of the gas in the capillaries of the gel, condensation takes place. The adsorption constant n in the Freundlich equation, $a = kP^n$ is no longer unity and decreases rapidly with a decrease in temperature. The temperature coefficient of adsorption is much greater below the discontinuity than above it. F. J. W.

4644. Absorption of Light and the Energy of Adsorption. J. H. de Boer. *Zeits. f. phys. Chem.* 18. *Abt.B.* 1. *pp.* 49–52, *July*, 1932.—If an adsorbed molecule absorbs light its energy of adsorption alters. If Q_A is the energy of adsorption for the normal molecule and $Q'_{A'}$ that of the molecule activated by radiation, the absorption band is shifted to the violet when $Q_A > Q'_{A'}$ and to the red when $Q_A < Q'_{A'}$. F. J. W.

4645. Rate of Absorption of Carbon Dioxide in Water and in Alkaline Media. J. W. Payne and B. F. Dodge. *Indust. and Engin. Chem.* 22. *pp.* 630–637, *June*, 1932.—The rate of absorption of CO_2 by water and solutions of Na_2CO_3, $NaHCO_3$ and NaOH in a small tower packed with glass rings has been studied. The rate of absorption by the carbonate and bicarbonate solutions was less than that of pure water. For the former the rate is independent of the concentrations of CO_2 and carbonate. A pure diffusional theory is unlikely to account for the results. F. J. W.

4646. Physical Properties of Mixtures of Acetone and Bromoform. Violet C. G. Trew. *Faraday Soc., Trans.* 28. *pp.* 509–514, *June*, 1932.—Results are given of determinations of the density, viscosity, refractive index, heat of mixing, and specific heat of a series of mixtures of acetone and bromoform in various proportions. In all cases deviations from the law of mixtures are observed. It seems probable that, as with acetone-chloroform mixtures, the deviations are due to molecular-compound formation, modified by other factors such as de-association of the one constituent in presence of the other. T. H. P.

4647. Gold-Silver Alloys as a Type of Continuous Solid Solution. W. Broniewski and R. Wesolowski. *Comptes Rendus*, 194. *pp*. 2047–2049, *June* 6, 1932.—Fifteen physical and mechanical properties of gold-silver alloys have been measured over the composition range 0–100 %, and in many cases over a wide range of temperature. Physical properties measured include electric conductivity and thermoelectric e.m.f. against lead at 0°; mechanical properties include Brinell hardness. F. J. W.

4648. Investigation of the System KCl-PbCl$_2$-H$_2$O at 25° C. L. J. Burrage. *Faraday Soc., Trans.* 28. *pp*. 529–531, *June*, 1932.—A detailed investigation has been carried out on this system at 25°, at concentrations near the quadruple point—PbCl$_2$ (solid), KCl. 2PbCl$_2$ (solid), vapour and solution. A parallelism has been noted between the solubility of PbCl$_2$ in KCl solutions and the molecular lowering of the vapour pressure of pure KCl solutions. AUTHOR.

4649. Thermodynamic Properties of Solid Solutions of Lead Chloride and Lead Bromide. A. Wachter. *Am. Chem. Soc., J.* 54. *pp*. 2271–2278, *June*, 1932.—An extension of previous work on the system NaCl-AgCl [see Abstract 2924 (1932)]. The present pair of salts form a series of solid solutions, with liquidus and solidus close together; factors favourable to experimentation. Maximum stability is shown by the solid solution containing 0·75 mol. of lead chloride, and a discontinuity in chemical action at this concentration is predicted. Thermodynamically, a regular arrangement of Br ions in the lattice of lead chloride is indicated. F. I. G. R.

4650. Lead-Rich Alloys of the Pb-Sb System Examined Thermodynamically. F. H. Jeffery. *Faraday Soc., Trans.* 28. *pp*. 567–569, *July*, 1932.—Sb combines directly with liquid Pb to form the compound Pb$_2$Sb which dissolves in excess of liquid Pb. This compound forms a solid solution in Pb and is probably the cause of the hardening effect produced when a small quantity of Sb is added to Pb. X-ray analysis [see Abstract 1712 (1931)] has failed to reveal the existence of this compound. It is suggested that the X-ray method failed owing to the difficulty of obtaining equilibrium conditions in the solid state. F. J. W.

4651. Solid Cadmium Amalgams. X-Ray Proof of the Compound Cd$_3$Hg. N. W. Taylor. *Am. Chem. Soc., J.* 54. *pp*. 2713–2720, *July*, 1932.—X-ray examination of solid Cd amalgams, which had been annealed *in vacuo* at 147° for 72 hours, indicates the existence of a new crystalline phase, body-centred tetragonal, with lattice constants $a = 16{\cdot}53$ Å., $c = 12{\cdot}09$ Å., $c/a = 0{\cdot}73$. The constants are probably correct to 0·3 %. This phase has a composition corresponding with Cd$_3$Hg. The structure is apparently derived from the ω type of solid solutions which characterise alloys poorer in Cd (down to 12 atomic %). Confirmation of the hexagonal close-packed structures of pure Cd and of an 80·8 atomic % of Cd amalgam has also been obtained. F. J. W.

4652. Solvent Properties of Soap Solutions. Parts I and II. E. L. Smith. *J. Phys. Chem.* 36. *pp*. 1401–1418, *May, and pp*. 1672–1684, *June*, 1932.—Although it is known that phenol and cresol are more soluble in soap solutions than in water, it is not generally recognised that the solvent power of soap solutions is perfectly general. It is shown that organic liquids in general are more soluble in soap solutions than in water, that liquids having a greater solubility than 2 % in water have a solubility of 10 % or more in a 0·4 N aqueous sodium oleate at 20° and lower the viscosity of the solution, whereas those liquids less soluble in water than about 2 % have a solubility less than 10 % in 0·4 N sodium oleate at 20° and increase the viscosity of the solution. It is stated that this behaviour is general and independent of the chemical nature of the organic liquid. Some liquids insoluble in water are found to be soluble in soap solutions and dependent on the method of preparation of the solutions. The phase equilibria possible for the fair-component systems soap, water, salt and an organic liquid are examined. Part II deals with the extraction of organic substances from soap solutions. Partition coefficients are obtained for the dye *p*-dimethyl-aminoazobenzene between ether and soap solutions. It is shown that the partition coefficients decrease greatly with increasing soap concentration, and slightly with methyl alcohol concentration, and with increasing excess alkali, in the soap solution. It is assumed the dye is adsorbed on the colloidal soap. A formula is given which appears to be confirmed by the results obtained. The partition coefficients are also measured for aniline between ethyl alcohol and sodium oleate solutions.

J. K.

4653. Viscosity of Silicic Acid Gel-Forming Mixtures and Influence of Non-Electrolytes thereon. M. Prasad, S. M. Mehta and J. B. Desai. *J. Phys. Chem.* 36. *pp.* 1384–1400, *May,* 1932.—The viscosity of solutions containing sodium silicate and acetic acid increases slowly after first mixing, probably as a result of the increase of the number of colloidal particles present; after a time the rate of increase of viscosity rises, and this is ascribed to neutralisation of the charge and consequent increased hydration of the particles, and to the formation of a definite structure. The influence of the acetic acid concentration on the rate of change may be explained in terms of the relation between the charge and hydration of the particles. The hydration, as calculated by Hatschek's method, increases some 100–200 fold before the gel has completely set. Alcohols increase the rate of increase of viscosity of alkaline and moderately acid mixtures but retard the rate in more strongly acid mixtures. The former effect is due to diminution of the dielectric constant of the mixture, but the cause of the latter remains obscure.

H. F. G.

4654. Obstruction of Ultra-Filters. F. Erbe. *Kolloid Zeits.* 59. *pp.* 32–44, *April, and pp.* 195–206, *May,* 1932.—An apparatus for measuring the flow of liquids through ultra-filters is discussed. Possible deviations from Poiseuille's law are discussed; the measurements carried out with cellulose and nitrocellulose filters at pressures up to 300 mm. show that there is (1) no evidence of turbulence; (2) gradual deposition of material in the pores, causing blocking; (3) a linear relationship between the permeability of membrane filters and the pressure; with cellulose filters, on the other hand, the permeability decreases with increasing pressure; (4) no retardation due to electroosmotic effects; (5) no "specific permeability" of a membrane when results for different liquids are compared, owing to the production of surface layers of different thicknesses in the capillaries. The validity of the Cantor formula has been examined for the case of a liquid forced through a membrane wetted with a second liquid incompletely miscible with the first. Factors which must be taken into account in determining the pore distribution in a membrane are

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discussed, and methods of determination applicable to cellulose and membrane filters are described. H. F. G.

4655. Static and Kinetic Study of Liesegang Rings. Suzanne Veil. *J. de Physique et le Radium*, 3. *pp*. 302–313, *July*, 1932.—A linear relationship is established between the square root of the inter-annular distance between successive rings and the numerical order of the rings. The opacity of the rings is sensibly constant throughout the sequence. The successive stages in the production of the rings have been investigated with the aid of a kinematograph, and the mechanics of the formation of the secondary ring system is discussed. The process of diffusion of the reactants, *viz.*, silver nitrate and potassium dichromate in gelatin, is examined. J. S. G. T.

4656. Rate of Coagulation of Stearic Acid Smokes. H. S. Patterson and W. Cawood. *Roy. Soc., Proc.* 136. *pp*. 538–548, *June* 1, 1932.—An apparatus is described capable of reproducing closely smokes volatilised at a low temperature. The smokes obtained exhibited initially a high degree of uniformity. Experimental results obtained with stearic acid smokes of the same weight concentration are given, and the velocity of coagulation is constant within small limits. The experimental velocities of coagulation are compared with values deduced from the Smoluchowski theory of coagulation as modified to apply to smokes. When account is taken of the fact that a smoke initially homogeneous must become heterogeneous owing to coagulation, the agreement between theory and experiment is good. The experiments indicate that the modified Smoluchowski theory represents to a close approximation the rate of coagulation of a smoke. [See Abstracts 375 and 376 (1930).] J. J. S.

4657. Influence of Charge on Velocity of Sedimentation of Colloids, Especially in the Ultra-Centrifuge. A. Tiselius. *Kolloid Zeits*. 59. *pp*. 306–309, *June*, 1932.—Reference is made to earlier work of the author on this subject [see Abstract 1185 (1927)]. It is shown that charge with respect to sedimentation of colloid particles appears to increase friction so that the particles take longer to sediment than if they are uncharged. This effect is noted only for very small particles. Such particles in strong fields do not sediment at all, but they can be made to sediment in centrifugal fields. This effect is therefore of importance for determining particle size. The influence of the addition of neutral salts at varying concentrations is determined. J. K.

4658. Microscope-Centrifuge and its Applications. E. N. Harvey. *Frank. Inst., J.* 214. *pp*. 1–23, *July*, 1932.—By means of a centrifuge forces are obtained similar to gravity and many times as great, and the sedimentation of a turbid suspension takes place rapidly. By a system of prisms or mirrors on the arm of the centrifuge, a stationary microscope on the axis and illumination by a discharge of 2000–3000 volts in mercury vapour at a special point in the path of the arm, the slide containing the material is examined *in situ*. This centrifuge gives the biologist a means of studying many problems in cell physiology. It may be put to other uses, *e.g.*, a study of stresses in crystals and transparent substances by the use of polarised light. H. M. B.

4659. Diffusion of Colloidal Particles. Part IV. H. R. Bruins. *Kolloid Zeits*. 59. *pp*. 263–266, *June*, 1932.—Partly as a result of Hartley and Robinson's work on the diffusion of colloidal electrolytes and other charged colloids [see Abstract 2204 (1932)], various considerations supplementary to the theory previously developed [see Abstract 1419 (1932)] are discussed. The results of two experiments concerned with the alteration of the velocity of diffusion during coagulation show that this velocity does not diminish but appreciably increases. This result cannot be explained in the light of the Einstein–Stokes equation, but, when the particle-charge is considered, can be interpreted in terms of the author's theory. T. H. P.

4660. Schaum Phenomenon. H. Reibstein. *Kolloid Zeits.* 59. *pp.* 337–342, *June,* 1932.—Many experiments are described generally supporting Schaum's explanation [see Abstract 1320 (1900)] of the motion observed in small crystals at a mercury-dilute acid interface, *viz.*, that the motion results from the reaction on the crystals of solution-currents in the liquid, and its speed upon the intensity of these latter and the viscosity of the liquid. The effect is observed in many crystals, not necessarily coming within Thiel's limitation of oxidation-reduction reactions with the acid, and the high diffusion gradients involved have their origin in the chemical and electrochemical properties of the experimental material and the osmotic inactivity of the reaction product (*e.g.*, MnO_2 in the case of $KMnO_4$ crystals). A further important factor controlling the motions is the interfacial tension at the Hg-acid interface, as influenced by the course of the reaction. L. V. C.

4661. Thermodynamics of Solvation Equilibrium in Colloidal Solutions. G. V. Schulz. *Zeits. f. phys. Chem.* 160. *Abt.A.* 6. *pp.* 409–424, *July,* 1932.—No theoretical formula has previously been deduced for the molar potential of the solvent in a sol $\mu_n = \frac{\partial Z}{\partial n}$, which is connected with the osmotic pressure of the sol by the equation $\pi = \frac{\mu_0 - \mu_n}{v_0}$, where μ_0 is the potential of the pure solvent and v_0 its molar volume, although satisfactory empirical formulæ for the osmotic pressure have been obtained. This is regarded as due to the solvation of a large part of the solvent. The molar potential of the solvent may be arrived at by calculating the molar potentials of the bound and free solvent separately, and equating these two partial potentials for the condition of equilibrium. Explicit functions are derived for the two potentials and it is shown how the simultaneous validity of these two functions may be tested by measuring the osmotic pressure (or swelling pressure). On the basis of the two functions it is possible to ascertain both the proportion of the solvent bound by solvation and the energy with which the disperse system retains this as solvate. In the light of these considerations, a hypothesis concerning the nature of the forces leading to solvation and swelling may be advanced [see Abstract 2622 (1932)]. T. H. P.

4662. Flame Temperatures of Mixtures of Ammonia with its Products of Dissociation. G. W. Jones, B. Lewis and H. Seaman. *Am. Chem. Soc., J.* 54. *pp.* 2166–2170, *June,* 1932.—The flame temperatures of H_2-N_2-air mixtures and NH_3-($3H_2 + N_2$)-air mixtures have been measured by the sodium line reversal method. The maximum flame temperature of the mixture $3H_2 + N_2$ is 1885° C., which is about the same as that found for methane or Pittsburgh natural gas burning in air. Results are given also for other N_2-H_2 mixtures. The maximum flame temperature of NH_3, determined by extrapolation is 1700°. These values are in good agreement with the calculated values. T. H. P.

4663. Flame Speeds During the Inflammation of Moist Carbonic Oxide-Oxygen Mixtures. W. Payman and R. V. Wheeler. *Chem. Soc., J. pp.* 1835–1838, *June,* 1932.—It has been shown previously by Payman that the maximum flame speed in certain series of mixtures of combustible gases with oxygen is given by the mixture containing the combustible gas and oxygen in combining proportions. Recently Bone and Fraser [see Abstract 2492 (1931)] have stated that in moist CO-O_2 mixtures the mixture giving the maximum initial speed of inflammation would be the one containing rather less than 80 % of CO. The authors have therefore repeated their experiments on moist (*i.e.*, saturated) CO-O_2 mixtures in a horizontal glass tube, and have confirmed their former result that the maximum speed mixture is one containing about 65 % of CO, *i.e.*, that corresponding approximately with the mixture $2CO + O_2$. T. B.

4664. Mechanism of Flame Movement. Part I. H. F. Coward and F. J. Hartwell. *Chem. Soc., J. pp.* 1996–2004, *July,* 1932.—Mason and Wheeler showed that the speed of "uniform movement" of flame in mixtures of CH_4 and air increases progressively with increase in the diameter of the containing tube and Chapman and Wheeler [see Abstract 166 (1927)] suggested that the relationship could be expressed for the data available for a 10 % CH_4-air mixture, by $V = cD^k$, where V is the velocity of the flame, D the diameter of the tube, and c and k are constants. It is now found that the true relationship is more complex and may be explained from the results of photographic analysis. In a tube of 2·5 cm. dia. the flame shows a straight-line front, but in a 20-cm. tube, although the speed is grossly constant, small irregularities occur in the flame-front, the horizontal section of the flame showing at every instant a complex geometrical pattern of luminous matter. In a 24-cm. tube, soon after ignition the flame has spread across the tube and has a smooth, almost hemispherical front, which becomes nodular after a moment and more tilted later. Another experiment shows that the movement of flame is not due solely to inflammation of successive layers of mixture but is affected by convection, which distorts the flame and tilts it forward, the upper part advancing the faster. The rapid increase in the speed of uniform movement with increase in tube-diameter above 20 cm. is thus explained by the disproportionately large increase in flame surface corresponding with the appearance of the nodular flame. T. H. P.

4665. Initiation of Gaseous Explosions by Small Flames. J. M. Holm. *Phil. Mag.* 14. *pp.* 18–56, *July,* 1932.—A theory of the failure of flames to travel along small tubes containing an explosive mixture is developed on the assumption that the extinction of the flame is caused primarily by the cooling effect of the unburnt gas in contact with the flame front. This is contrary to the usual assumption, *i.e.*, that the extinction is due chiefly to the cooling effect of the walls of the tube. An approximate formula connecting the limiting diameter required for propagation with various constants of the gaseous mixture is deduced. In Part I of the experimental work, no satisfactory evidence of the existence of a time of contact prior to ignition could be obtained, but it was found that the actual size of the flame exposed to the mixture has a very important bearing on whether ignition takes place or not. In Part II, the actual arrangements and methods used for determining the limiting diameters for propagation along tubes and for ignition through circular apertures in thin plates are described. A detailed description and photographs are given of an almost spherical flame which may burn inside the explosive mixture for several seconds without producing general ignition. It is shown that the area of the limiting aperture for ignition through thin plates does not remain constant as its shape is changed. The curves connecting the limiting diameter, *d*, with the percentage composition of the combustible gas in the mixture, *c*, are represented by $d = d_0 + \alpha(c - c_0)(e^{\beta(c-c_0)} - 1)$, where (c_0, d_0) are the coordinates of the minimum and (α, β) are constants. H. H. Ho.

4666. Ignition of Firedamp by Explosives. Study of the Process of Ignition by the Schlieren Method. W. C. F. Shepherd. *Bureau of Mines, Bull.* 354. [89 *pp.*], 1932.—The research is divided into two sections. In the first the firedamp-air mixtures in a gallery of 30 cm. dia. and 365 cm. long are ignited by means of detonating gas mixtures of H_2 and O_2, contained in a long narrow steel tube, one end of which projects into the gallery. In the second section " permissible explosives " are used to ignite the firedamp-air mixtures. The Schlieren method of photography is used in connection with the " wave-speed camera " formerly developed by Payman and the author. Many photographs and diagrams are given in the paper, and amongst the conclusions arrived at are the following: (1) The firedamp-air mixture is ignited by contact with the hot products projected from the steel tube behind the detonation wave. (2) The igniting power is greatest at the advancing nose of the body of products. (3) The chemical nature of the products and the oxygen balance of the original explosive are important factors in deciding the mixture most easily ignited. (4) In the case of the solid explosives ignition is brought about (*a*) by the primary flame with which the shock wave is associated, (*b*) by the hot products and (*c*) as a result of the forms of the shock waves reflected from the walls of the gallery. T. B.

4667. Absolute Measure of the Available Energy of High Explosives by the Ballistic Mortar. W. Taylor and G. Morris. *Faraday Soc., Trans.* 28. *pp.* 545–558, *June*, 1932.—The essential principle of the mortar test is that the explosive, instead of being caused to do work against a varying and unknown resistance, as in the popular Trauzl lead-block test, is fired in a suitable type of gun, so that the work done in the expansion of the products of detonation may be measured in absolute mechanical units. A massive mortar is slung as a ballistic compound pendulum, and a recording device automatically registers the angle of recoil. Discrepancies between results obtained and the simple ballistic theory are found to be due to heat lost to the walls, gas leakage and effects due to the primer. The equation for energy, $Q = kw - C(1 - e^{-aw})$, is found to be a good empirical fit to the experimental results, where w is the weight of charge, k is the " true " energy per gm. of explosive, and C and a are constants depending on the explosive. T. B.

4668. Time of Combustion of Flashlight Powder. S. Kalyanaraman. *Phil. Mag.* 14. *pp.* 158–160, *July*, 1932.—The powder was supported in a spoon on a wheel revolving at a known rate in a darkened chamber. On igniting the powder electrically, the duration of combustion could be deduced from the length of the luminous arc of the wheel, registered photographically. The combustion was found to begin and end gradually, the mean time of combustion in the case studied being 0·058 sec. for the period of full combustion. The time depended on the manner in which the powder was disposed in the spoon. J. H. A.

4669. Free Energy, Heat Content and Entropy of Iodine Monochloride. J. McMorris and D. M. Yost. *Am. Chem. Soc., J.* 54. *pp.* 2247–2256, *June,* 1932.—By investigation of the equilibria $2BaPtCl_6 + I_2 \rightleftharpoons 2BaCl_2 + Pt + PtCl_4 + Cl_2 + 2ICl$ between 368° and 474°, and $2NOCl + I_2 \rightleftharpoons 2NO + 2ICl$ between 136° and 179°, the free energy equation for the reaction $1/2I_2(g) + 1/2Cl_2(g) = ICl(g)$ is determined to be $\Delta F^\circ = -3125 - 1{\cdot}77T$, as compared with $\Delta F^\circ = -3461 - 1{\cdot}40T$ deduced from spectroscopic data [see Abstracts 655 (1930) and 2269 (1931)]. The free energies of formation of gaseous, liquid and solid ICl from solid iodine and gaseous chlorine are respectively 977, −867 and −887 cal. Gaseous ICl is dissociated to the extent of 0·42 % at 25° and 1·58 % at 100°. The entropy of ICl(*g*) at 25° and one atmosphere is 59·6 cal./°, or from spectroscopic data 59·2. C. A. S.

4670. Additivity of the Energies of Normal Covalent Bonds. L. Pauling and D. M. Yost. *Nat. Acad. Sci., Proc.* 18. *pp.* 414–416, *June,* 1932.—The authors' postulate that the energies of normal covalent bonds are additive is supported by the fact that the deviations of the observed bond energies of the hydrogen and halogen molecules from the values calculated additively are always positive. For HF the deviation is nearly as large as the total energy of the normal covalent bond, on account of the great influence of the ionic structure, whereas with HI the deviation approximates closely to the total bond energy, since the structure is of the normal covalent type. ClF is more ionic than HF, but BrI and ICl are less so. The additive law is approximately true for KNa and LiH, whereas for the ionic alkali halides large deviations are observed. The criterion of additivity is proposed as a useful means of interpreting the nature of a chemical bond. H. F. G.

4671. Equivalent Chemical Bonds Formed by s, p and d Eigenfunctions. R. Hultgren. *Phys. Rev.* 40. *pp.* 891–907, *June* 15, 1932.—The work of Pauling [see Abstract 2876 (1931)] on the linear combinations of eigenfunctions to form bond functions has been extended. A theorem concerning the maximum strength in a given direction of a bond function orthogonal to existing bond functions has been derived. It is found that the strongest bond functions must lie at such angles to one another that the maximum of each coincides with a node of each of the others. A general expression for equivalent Pauling bond functions formed from linear combinations of *s*, *p* and *d* eigenfunctions has been derived. By assuming the bond functions to have cylindrical symmetry, like the best possible bond functions, the equations can be readily solved. It is found that equivalent cylindrical bond functions will be orthogonal if the angles between every pair have no more than two values. The angles must be greater than 54°44′ and their sum must be greater than 180°; otherwise they are unrestricted. No more than six such bond functions may be formed. Solutions for six and less equivalent bond functions are given. There are only four possible configurations for six equivalent cylindrical bond functions. Two of these are much weaker than the other two and so are improbable. The configurations for the

stronger bond functions are in striking agreement with the only two structures, the octahedron and the trigonal prism, which are found experimentally. A discussion of the factors influencing bond energies is made and examples of chemical compounds cited. It is predicted that the structure of P_4 is that of a tetrahedron with a P atom at each corner.
AUTHOR.

4672. Reactions of Alcoholic Crystal Violet Leuco-Cyanide Solutions in the Light and in the Dark. Edith Weyde, W. Frankenburger and W. Zimmermann. *Zeits f. phys. Chem.* 17. *Abt.B.* 4–5. *pp.* 276–284, *June,* 1932.—In the photochemical conversion of the leuco-cyanide into crystal violet, one molecule of dyestuff is formed per quantum absorbed (2537–3130 Å.); the reaction is independent of temperature between $-6°$ and $+40°$ C. The reaction proceeds in the reverse direction in the dark, and is accelerated by addition of KCN; the velocity of the "dark" reaction increases 5 times for 10° C. rise of temperature, and is greatly reduced by traces of water. Irradiation of a leuco-cyanide solution containing KCN appears to cause slow but complete decomposition of the dye at first formed, but actually it is the nitrile resulting from the reversed "dark" reaction which decomposes. The absorption spectra of the various substances concerned have been determined. H. F. G.

4673. Photochemical Decomposition of Ozone in Red and in Ultra-Violet Light. H. J. Schumacher and U. Beretta. *Zeits. f. phys. Chem.* 17. *Abt.B.* 6. *pp.* 405–428, *June,* 1932.—The kinetics of the decomposition of ozone in red light is in quantitative agreement with the scheme: (1) $O_3 + E = O_2 + O$; (2) $O + O_3 = 2O_2^{*}$; (3) $O + O_2 + M = O_3 + M$ ($M = O_2$ or O_3); (4) $O_2^{*} + O_3 = O_2 + O_2 + O$; (5) $O_2^{*} + O_3 = O_2 + O_3$; (6) $O_2^{*} + O_2 = 2O_2$ [see Abstract 3889 (1930)]. The significance of each of these reactions is discussed. In ultra-violet light ($\lambda = 313\ \mu\mu$) the decomposition proceeds according to the same scheme and with the same velocities. When a foreign gas (X) is present, the reactions (3′) $O + O_2 + X = O_3 + X$ and (7) $O_2^{*} + X = O_2 + X$ also occur. For the constants of the reaction, the ratios $k_3 : k_2$ and $k_5 : k_4$ can be calculated accurately and the ratios $k_3' : k_2$, $k_6 : k_4$ and $k_7 : k_4$ less accurately.
T. H. P.

4674. Action of Light upon Sulphite Solutions. F. Haber and O. H. Wansbrough-Jones. *Zeits. f. phys. Chem.* 18. *Abt.B.* 2–3. *pp.* 103–123, *July,* 1932.—In consonance with Franck and Haber's theory, the action of light upon oxygen-free alkali sulphite solutions produces the anticipated secondary products, H_2SO_4, H_2 and dithionic acid, in noteworthy dependence on the alkalinity. In oxygen-containing solution, the autoxidation produced by light exhibits the same dependence on alkalinity which was established for the development of H_2 in the absence of dissolved O_2. The conditions are recorded for the proportionality of the autoxidation upon the oxygen pressure. H. H. Ho.

4675. Photochemical Decomposition of Organic Anions and Free Acids in Ultra-Violet Light. L. Farkas and O. H. Wansbrough-Jones. *Zeits. f. phys. Chem.* 18. *Abt.B.* 2–3. *pp.* 124–145, *July,* 1932.—Part I deals with the chemical changes which occur in the electronic affinity spectrum for the anions of sodium formate, acetate and succinate respectively. Comparison with sulphite decomposition reveals a series of analogies, the reaction being $RCOO'(H_2O) + h\nu \rightarrow RH + HCO_3'$, which an addition of alkali (in certain cases of NaCl) reverses and produces hydrocarbon with hydrogen and a high basic acid. In Part II the decomposition of the undissociated acids (acetic propionic, butyric and succinic) in aqueous solution follows the equation, $R.COOH + h\nu \rightarrow CO_2 + RH$. For acetic and propionic acids, the reaction $RCOOH(H_2O) + h\nu \rightarrow ROH + HCOOH$ requires greater acidity, since esterification tends to occur, and consequently ensues less readily than the CO_2 reaction. With butyric acid the reaction, $C_3H_7COOH + h\nu \rightarrow C_2H_4 + CH_3COOH$, also occurs, and with succinic acid, $C_2H_4(COOH)_2 + h\nu \rightarrow 2CO_2 + C_2H_6$. Experiments have also been conducted in the vapour state and in hexane solution. In the former, the absorption of acetic acid is continuous, the simple molecule reacting as $CH_3COOH + h\nu \rightarrow CH_4 + CO_2$ and the double molecule as $(CH_3COOH)_2 + h\nu \rightarrow CO + CO_2 + C_2H_6 + H_2O$. In hexane solution both the acetic acid and hexane are decomposed. All the data are discussed. H. H. Ho.

4676. Quantum Yield in the Photochemical Decomposition of Gaseous Hydrazine. R. R. Wenner and A. O. Beckman. *Am. Chem. Soc., J.* 54. *pp.* 2787–2797, *July,* 1932.—The quantum yield for this decomposition by monochromatic radiation of wave-length 1990 Å. varies from 1·0 (molecules of N_2H_4 decomposed per quantum of radiation absorbed) at 2 mm. to 1·7 at 14 mm. pressure. In agreement with the results of previous investigators, the products of the decomposition are found to be NH_3, N_2 and H_2, but the relative proportions of these products differ from those given earlier. The composition of the products is a function of the pressure of the N_2H_4, more H_2 being formed when this pressure is low. The mechanisms previously proposed for the photosensitised decomposition of N_2H_4 are not applicable to the photochemical decomposition, for which a possible mechanism, consistent with the experimental data, is suggested. T. H. P.

4677. Photolysis of Hydrogen Peroxide in Aqueous Solution. L. J. Heidt. *Am. Chem. Soc., J.* 54. *pp.* 2840–2843, *July,* 1932.—A quantum yield approaching unity as the concentration of H_2O_2 is decreased has been obtained for its photolysis in aqueous solution at 28 ± 2°, using light of high intensity at 313 $m\mu$ from a monochromator. H. H. Ho.

4678. Photochemical Mercury-Sensitised Reactions between Hydrogen, Oxygen and Carbon Monoxide. M. Barak and H. S. Taylor. *Faraday Soc., Trans.* 28. *pp.* 569–581, *July* 1932.—In static systems at 14° C. the interaction of H_2 and O_2 under the influence of excited Hg shows an auto-acceleration when H_2-rich mixtures are employed. In mixtures either rich in O_2 or containing CO the rate of reaction is approximately constant. The average rate is maximum for $2H_2 + O_2$ mixtures. With equal concentrations of H_2 and CO, oxidation of the former is five times as rapid as that of the latter under the influence of excited Hg. The interaction of H_2 and CO occurs at approximately 18 % of the rate $(-d[H_2]/dt)$ for electrolytic gas or CO-electrolytic gas mixtures under similar experimental conditions. The data obtained are consistent with an initial and substantially exclusive formation of H_2O_2 in O_2-containing mixtures and with a reaction sequence involving short chains having a mean chain-length of approximately six. T. H. P.

4679. Photochemical Formation of Phosgene at Low Pressures. E. Warming. *Zeits. f. phys. Chem.* 18. *Abt.B.* 2–3. *pp.* 156–158, *July,* 1932.—The theory advanced by Bodenstein, Lenher and Wagner to explain the results of their measurements of the photochemical formation of phosgene at low pressures [see Abstract 392 (1930)] is considered. This theory could not be developed since the following mathematical problem was left unsolved: Given a differential equation $\frac{d^2\eta}{d\xi^2} + \mu(1 - \eta^2) = 0$, with the limiting conditions $\eta = 0$ for $\xi = \pm 1$, it is required to find the mean value $\bar{\eta}$ of η in the interval $-1 < \xi < 1$ for any value of the parameter μ. A solution of this problem now given reveals good agreement between the theory and the experimental results. T. H. P.

4680. Action of X-Rays on Ferrous Sulphate Solutions. N. A. Shishacow. *Phil. Mag.* 14. *pp.* 198–203 *July* 1932.—Consists in part of a criticism and in part of an extension of the work of Fricke and Morse on this subject. Evidence is brought forward that oxygen accelerates the reaction and also that hydrogen is oxidised, its formation being explained thus: $2FeSO_4 + H_2SO_4 = Fe_2(SO_4)_3 + H_2$. J. H. A.

4681. International Weston Element. E. König and F. Buchmüller. *Helv. Phys. Acta*, 5. 3. *pp.* 166–173, *June*, 1932.—The influence of sulphuric acid at various concentrations on the stability and reproducibility of the e.m.f. of the Weston cell has been determined. The mean deviation from the normal is greatest when the electrolyte is neutral, and least when the sulphuric acid concentration is somewhat below 0·1 *M*; with 0·025–0·05 *M* acid solutions the deviation assumes intermediate values. H. F. G.

4682. New Determination of the E.M.F. of the International Weston Element. H. v. Steinwehr and A. Schulze. *Zeits. Instrumentenk.* 52. *pp.* 249–260, *June*, 1932. *From the Reichsanstalt.*—An account is given of a new determination of the e.m.f. of the international Weston element carried out by means of the silver voltameter with the cooperation of the Bureau of Standards, the National Physical Laboratory and the Physikalisch-Technischen Reichsanstalt. The results of the observations are given in tables. These are regarded as correct to $1/10^5$, so that further measurements are not necessary. The result of 21 years of international cooperation in Washington is confirmed, according to which the e.m.f. of the Weston international element is to be taken as 1·01830 volt. J. J. S.

4683. Maximum Available Energy and Entropy for the Formation of Silver Bromide from its Elements. H. Woitinek. *Zeits. f. Elektrochem*, 38. *pp.* 359–365, *June*, 1932.—The results are given for investigating the reaction of $Ag_{solid} + \frac{1}{2}Br_{2\,gas} = AgBr_{solid}$ in the galvanic element: $Ag|AgBr|0{\cdot}5N HBr//0{\cdot}5N HBr + Br_{2\,unsaturated}|Pt$. The e.m.f. is determined for 25° and 0° C., and hence the temperature coefficient at 12·5° C. The values are applied in calculating ϵ_s and $\left(\frac{\partial \epsilon_s}{\partial T}\right)_p$ for the condensation reaction $Ag_{solid} + \frac{1}{2}Br_{2\,liquid} = AgBr_{solid}$. From these are determined the free energy and the reaction entropy of the condensation reaction. Deviations from the Nernst Theorem in this connection are determined. J. K.

4684. Thermodynamic Properties of Fused Salt Solutions. E. J. Salstrom. *Am. Chem. Soc., J.* 54 *pp.* 2653–2661, *July*, 1932.—The e.m.f. of the cell Ag(solid) | $AgBr + PbBr_2$(liquid) | Br(gas) at temperatures between 425° and 575° C. and with from 10 to 100 mol.-% of AgBr in the liquid phase has been measured. The e.m.f.-temperature curves are linear. The relationships between the composition of the liquid phase and the free energy, heat of formation, entropy change and activity coefficient of the AgBr and between the composition and the free energy and activity coefficient of the $PbBr_2$ have been calculated for several temperatures. The activities of both salts are in close agreement with the values calculated on the basis of Raoult's law, particularly if it is assumed that both salts are un-ionised. H. F. G.

4685. Use of Amplifying Valves for Measuring E.M.F. of Cells. F. Müller. *Zeits. f. Elektrochem.* 38. *pp.* 418–428, *July,* 1932.—When a galvanic cell has a very high internal resistance or becomes polarised for a very small current output, its e.m.f. cannot be measured by the ordinary Poggendorff compensation method. This can, however, be done with the help of an amplifying valve apparatus, the energy-exchange with the cell and the voltage-sensitivity being the crucial factors. Each of these factors is critically examined in relation to systematic measurements, the limits of applicability of the method are described, and a suitable arrangement outlined. [See also Abstracts 241 (1932) and 2824 (1929).] T. H. P.

4686. Use of the Valve in Electrometric Titrations. J. L. Kassner, R. B. Hunze and J. N. Chatfield. *Am. Chem. Soc., J.* 54. *pp.* 2278–2284, *June,* 1932.—A positive grid potential is used in place of the usual negative. The general arrangement is such that a 20 % range in the variables is obtained without vitiating the results. The equivalence point is obtained from the " kick " of a sensitive galvanometer. Adjustments during titration are unnecessary. F. I. G. R.

4687. Antimony Electrode for Electrometric Determination of Magnesium. B. B. Malvea and J. R. Withrow. *Am. Chem. Soc., J.* 54. *pp.* 2243–2247, *June,* 1932.—A stick Sb electrode acts satisfactorily in place of an H electrode for the determination of Mg in pure solutions or mixed with Ca, provided that for Mg alone the concentration is $\nless$ 0·01 g. MgO per 150 c.c.; or, if in presence of Ca and in fairly strong solution, the amount of Ca is $\ngtr$ 8 times that of Mg, the maximum error being 3·5 %. With 25–30 times as much Ca as Mg the method fails; it is also unreliable if the solution is dilute as regards Mg. C. A. S.

4688. Use of Glass Electrode in Electrometric Titration. H. T. S. Britton and R. A. Robinson. *Faraday Soc., Trans.* 28. *pp.* 531–545, *June,* 1932.—Critical examination of the use of the glass electrode in titrimetric work has given the following results: (*a*) accurate pH values are registered in buffered solutions from pH 2 to 12; (*b*) errors with unbuffered solutions are confined to the narrow regions in which wide variation of the pH values occur; (*c*) presence of a precipitate does not interfere with the accuracy of the electrode; (*d*) pK values of a number of acids have been determined; (*e*) computation of the solubility product of AgOH from the glass electrode pH values gives a value agreeing with previous data; (*f*) the pH curves corresponding with the titration of zinc salts with alkali reported by Kolthoff and Kameda, and by Prytz, are reproduced; (*g*) although the solubility product principle applies to the precipitation of AgOH, and possibly of $Mg(OH)_2$, this principle is untenable in the case of the formation of the basic precipitates generally. The use of the pH value prevailing at a single point in such a precipitation cannot therefore be expected to lead to an accurate knowledge of the true solubility product. T. H. P.

4689. Glass Electrode. G. Haugaard. *Zeits. f. phys. Chem.* 160. *Abt.A.* 3–4. *pp.* 279–289, *June*, 1932.—The p.d. at the two surfaces of a glass electrode consisting of a tube with thin bulb at one end, with solutions of varying pH inside and outside, is shown to depend solely on the solution at the surface concerned, the glass " membrane " acting solely as a boundary wall. Similar determinations with 0·1 *N* HCl inside and solutions of varying concentration of LiCl, NaCl or KCl outside are in at least qualitative agreement with the theory that the p.d. is due to a double layer consisting of the smaller of the two ions next the glass, and the larger further away therefrom. The possibility of such a double layer being produced where the ions are of different valency by the differences in the dielectric constants of solution and glass is discussed. C. A. S.

4690. Glass Electrodes. S. I. Ssokolof and A. H. Passynsky. *Zeits. f. phys. Chem.* 160. *Abt.A.* 5. *pp.* 366–377, *July*, 1932.—The behaviour of glass electrodes (containing Li, Na and K) in alkaline solutions of Li-, Na-, K-, Rb- or Cs-ions shows that the magnitude of the deviations of these electrodes from their normal functions as hydrogen electrodes is dependent on the radii of the respective kations in the glass and water phases (without taking account of the hydration envelope). Such deviations are greatest when the kations are alike in glass and solution, and are least when the radius of the kation in the glass is less than that in the solution. This relation is explained by the fact that the electrode functions of the glass depend upon the mechanism of passage of the kations from the water into the glass phase. H. H. Ho.

4691. Haber Glass Electrode. J. Zirkler. *Zeits. f. Physik,* 77. 1–2. *p.* 126, *July* 19, 1932.—Results obtained with the glass electrode are attributed to the different degrees of devitrification of the outer and inner surfaces of the glass sphere, due to the different rates of cooling; as a consequence, piezoelectric effects occur. H. F. G.

4692. Influence of H.F. Currents on Polarised Electrodes. Part I. S. Glasstone and G. D. Reynolds. *Faraday Soc., Trans.* 28. *pp.* 582–596, *July*, 1932.—The decrease of polarisation of an electrode resulting from the application of h.f. currents (called the h.f. effect) is found to be approximately proportional to the h.f. current density. At high polarising current densities this h.f. effect is small and almost independent of the nature of the gas saturating the electrolyte; the magnitude of the effect for a given h.f. current density appears to be proportional to the fall of h.f. e.m.f. across the cell. At low polarising current densities the h.f. effect is very large in solutions saturated with air or O_2, but small in presence of H_2 or N_2; although limited by the resting potential of the electrode, the effect appears to be related to the h.f. e.m.f. Measurement of the minimum H overvoltage at Pt and Pb kathodes under various conditions shows that, although the h.f. oscillations do not affect the minimum overvoltage they markedly affect the value of the residual current, especially in presence of depolarisers. The h.f. effects on polarised electrodes and the mechanism of the " electrolytic detector " are accounted for by assuming that the depolarising influence of h.f. currents is due to the production of an increase in the rate of diffusion of active material from, and of depolariser to, the electrode. The magnitude and mechanism of the h.f. effect appear to be the same at both anode and kathode. T. H. P.

4693. Surface Conductance at Glass-Salt Solution Interfaces. H. L. White, F. Urban and E. A. van Atta. *J. Phys. Chem.* **36.** *pp.* 1371–1383, *May,* 1932.—A method and apparatus for determining the stream potential or resistance of pyrex glass capillaries filled with an electrolyte are described; resistances up to $2 \cdot 2 \times 10^{11}$ ohms are measured by a condenser discharge method. No polarisation takes place, and the resistance does not change with time. Measurements with $0 \cdot 0005\ N$ KCl solution in capillaries of up to 0·00182–0·10 mm. bore and having surface area to volume ratios of up to 22,000 : 1 yield for the specific surface conductance of pyrex glass the value $2 \cdot 24 \times 10^{-9}$ mhos, which is only 1/45 of that obtained by extrapolation from the data given by McBain, Peaker and King. It is suggested that the values obtained by these workers were influenced by contamination of the electrolyte by chromic acid or by electrolytes from the glass. H. F. G.

4694. Electrical Conductivity of Aqueous Solutions of Hydrogen Sulphide and the State of the Dissolved Gas. R. H. Wright and O. Maass. *Canad. J. of Research,* 6. *pp.* 588–595, *June,* 1932.—Electrical conductivities of aqueous solutions of hydrogen sulphide have been measured between 5° and 60° C. The results lead to the conclusion that H_2S resembles certain other gaseous solutes and forms with water a complex which undergoes electrolytic dissociation. The constant *k* of the Ostwald dilution law therefore appears to be an apparent, rather than a real, dissociation constant. The complete analysis of the equilibria involved and the evaluation of the constants must depend on accurate measurements at low concentrations, which are not yet completed. [See also Abstract 2917 (1932).] AUTHORS.

4695. Dispersion of the Conductivity of Mixtures of Aqueous Electrolytes. M. E. Spaght. *Phys. Zeits.* 33. *pp.* 534–536, *July* 15, 1932.—The dispersion effect of mixtures of calcium ferrocyanide with KCl, HCl and KOH in aqueous solution has been measured. In each of the three cases, the maximum of the effect lies at a position of lower concentration than for pure calcium ferrocyanide. This is regarded as due partly to the fact that the presence of foreign ions means an increased concentration, and in this way causes diminution of the relaxation time. This cause is insufficient to explain fully the results, and it is supposed also that increase in the number of ions present produces an augmentation of the interionic forces, and hence of the braking forces. The curves obtained in the three cases show differences, which express the individualities of the added ions, these appearing to show up more than when the pure electrolytes are compared. T. H. P.

4696. Conductivity Measurements of Alkylated Ammonium Picrates in Water. P. Walden and E. J. Birr. *Zeits. f. phys. Chem.* 160. *Abt.A.* 5. *pp.* 327–336, *July,* 1932.—This paper continues a previous investigation [see Abstract 2513 (1931)], and records the conductivity data at 18° C. for aqueous solutions of the following alkylated ammonium picrates: *n*-butyl, isobutyl-, diethyl-, di-*n*-propyl-, tetramethyl-, trimethyl-*n*-propyl-, dimethyl-*n*-propyl-, methyltri-*n*-propyl-, triethyl-*n*-propyl, diethyldi-*n*-propyl, ethyltri-*n*-propyl and tetra-*n*-propyl-. From the limiting conductivities of these salts, the mobilities of the single ammonium ions have been calculated by the aid of the product $l \,.\, \eta = 0{\cdot}267$ for the picrate ion, and compared with the values derived from Bredig's conductivity measurements of alkylated ammonium chlorides. The ionic mobilities in water are compared with those in non-aqueous solvents and deviations discussed. H. H. Ho.

4697. Conductivity Measurements in Pyridine. P. Walden, L. F. Audrieth and E. J. Birr. *Zeits. f. phys. Chem.* 160. *Abt.A.* 5. *pp.* 337–365, *July,* 1932.—The density, viscosity and conductivity of pyridine have been determined at 25° C. as 0·97792, 0·008824 and $4{\cdot}0 \times 10^{-8}$ respectively. Exact conductivity measurements at 25° C. up to dilutions of V = 50,000 l. have been made for the following salts in pyridine solution: tetramethyl-ammonium picrate; tetraethyl ammonium-picrate, -chloride, -bromide, -iodide, -nitrate, -perchlorate; tetrapropylammonium picrate and perchlorate; tetra-iso-amylammonium picrate and perchlorate; diethylammonium picrate and chloride; ethylammonium picrate; pyridonium picrate; piperidonium picrate; lithium-, sodium-, potassium- and silver picrates; silver nitrate and sodium iodide. The validity of the Kohlrausch square root law is established for strong and fairly strong salts, in pyridine solution, as well as the law of the independent migration of ions. Deviations from the Walden rule are found for the salts of tetra-alkylated ammonium ions, and attributed to their abnormal behaviour. It is shown that the assumption of a Grotthus conductivity for the pyridonium ion is unnecessary. H. H. Ho.

4698. Crowding Effects in Current Flow through Small Tubes and Slits. H. L. White, L. C. and E. A. van Atta. *J. Phys. Chem.* 36. *pp.* 1364–1370, *May,* 1932.—The abnormal resistance of an electrolyte occupying a narrow slit, *e.g.,* between glass plates, termed the "pinch effect," is not observed with tubular capillaries of 0·008–0·1 mm. bore. This fact, in conjunction with a theoretical study of the case of an ellipse of great eccentricity, suggests that the reported increases of resistance of concentrated solutions is not due to a "pinch effect," but to a systematic error of unknown origin. H. F. G.

4699. Mobilities of Anions of Weak Acids. C. W. Davies. *Faraday Soc., Trans.* 28. *pp.* 607–609, *July,* 1932.—The solvent correction to be applied to conductivity measurements on salts of weak acids is described. The example of calcium oxalate is then discussed, and the use of the "normal" correction shown to lead to errors of many units in the conductivities, and hence in the mobility value derived from them. H. H. Ho.

4700. Activity Coefficients of Benzoic Acid, Benzoate Ion and Silver Benzoate in Solutions of Neutral Salts. I. M. Kolthoff and W. Bosch. *J. Phys. Chem.* 36. *pp.* 1685–1711, *June,* 1932.—The solubility of benzoic acid in water at 25° is found to be $0{\cdot}02775 \pm 0{\cdot}00002$ mol. per litre; and the activity 0·02635 to 0·0264. The influence of various neutral salts on the activity of benzoic acid has been determined, and the data interpreted in the light of the salting-out effect due to the kation with resulting increased solute activity, and the mutual deforming effect due to the anion with production of decreased activity of the solute. The activity coefficient of the benzoate ion in the presence of various electrolytes passes through a minimum at about $0{\cdot}25\,N$ KCl, but at a higher concentration for NaCl and still higher for LiCl. The kation effect may reverse at high ionic strengths, and it is in any case pronounced, whereas the anion effect in relatively dilute solutions is very small. The solubility of silver benzoate in water at 24° is 0·01162 ± 0·00002 mol. per litre. The salt is not completely ionised in its saturated solution. The mean and the individual ion activity coefficients of silver benzoate have been determined in various salt solutions. A special study has been made of the silver electrode, whose normal potential measured against quinhydrone in 0·01 N HCl and 0·09 N KCl as reference electrode is $0{\cdot}2269 \pm 0{\cdot}0002$ volt, or $E_0H = 0{\cdot}8030 \pm 0{\cdot}0002$ volt at 25° C. The activity coefficient of Ag ions in 0·01 N $AgNO_3$ in the presence of neutral salts has been determined. H. H. Ho.

4701. Activity Coefficient of Potassium Chloride in Aqueous Solution from Boiling Point Data. B. Saxton and R. P. Smith. *Am. Chem. Soc., J.* 54. *pp.* 2626–2636, *July*, 1932.—The rise of boiling point of aqueous solution of KCl has been measured in two forms of apparatus, up to concentrations of 7·8 molal, when the rise is about 8·6° C. The activity coefficients are computed from the data, using the Debye–Hückel theory for the dilute part of the range. The results are compared with various theories and with activity coefficients determined by other observers at lower temperatures. J. H. A.

4702. Activity Coefficient of Zinc Sulphate from E.M.F. Measurements. K. Masaki and T. Ikkatai. *Chem. Soc. Japan, Bull.* 7. *pp.* 238–246, *July*, 1932.—Measurements have been made of the e.m.f. of the cell Zn-Hg (saturated amalgam)$|ZnSO_4(m)$, $Hg_2SO_4(s)|Hg$ at 25° C. at concentrations ranging from 0·0004321 to 3 molal. At higher dilutions the e.m.f. is abnormal, owing to the solubility of the mercurous sulphate. The mean activity coefficients of $ZnSO_4$ for the more concentrated solutions are calculated with the help of Cowperthwaite and la Mer's data for dilute solutions [see Abstract 2191 (1932)], and it is found that the potential E_0 of the cell when ion activities of $ZnSO_4$ are hypothetically 1 molal, is 1·37475 volts at 25° C. T. H. P.

4703. Transference Numbers of Potassium, Sodium and Lithium Chlorides, and of Hydrochloric Acid at 25° L. G. Longsworth. *Am. Chem. Soc., J.* 54. *pp.* 2741–2758, *July*, 1932.—The moving-boundary method was used, and apparatus similar to that previously described [see Abstract 3894 (1930)]. A formula is given for the correction required for the conductance of the solvent (considerable for concentrations $< 0{\cdot}02\ N$), but not being satisfactory this was deduced from direct measurements in absence of solute. Corrected for this and for volume changes the transference numbers at 25° for KCl, NaCl, LiCl and HCl at concentrations of 0·01 and 0·1 N are respectively 0·4903 and 0·4898, 0·3918 and 0·3854, 0·3289 and 0·3168, 0·8251 and 0·8314, in close agreement with those obtained by both the Hittorf and e.m.f. methods. An equation relating these numbers to concentration extrapolatable to zero concentration is given. [See following Abstract.] C. A. S.

4704. Limiting Equivalent Conductances of Several Univalent Ions in Water at 25°. D. A. MacInnes, T. Shedlovsky and L. G. Longsworth. *Am. Chem. Soc., J.* 54. *pp.* 2758–2762, *July*, 1932.—From the conductances of the aqueous solutions and transference numbers [see preceding Abstract] the equivalent conductances, Λ, of the chlorides and acid, and transference number and equivalent conductance, λ_{Cl}, of the chloride ion have been determined for four concentrations each of KCl, NaCl, LiCl and HCl, showing (save for $0 \cdot 1\,N$ LiCl) good agreement with experimental results. λ_{Cl} deduced from all four chlorides is almost the same for concentrations $0 \cdot 01\,N$ and $0 \cdot 02\,N$, but shows increasing differences as concentration increases. Shedlovsky's equation applied to all four results gives $\lambda_{0\text{Cl}} = 76 \cdot 32$, whence with the values of Λ_0 previously obtained the following values of the limiting conductances, λ_0 at 25°, are deduced: $K^+ 73 \cdot 50$, $Na^+ 50 \cdot 10$, $H^+ 349 \cdot 72$, $Ag^+ 61 \cdot 90$, $Li^+ 38 \cdot 68$, $NO_3^- 71 \cdot 42$, $CH_3CO^- 40 \cdot 87$. C. A. S.

4705. ζ-Potential and Abnormal Tenacity in the Double Layer. H. Reichardt. *Zeits. f. phys. Chem.* 159. *Abt.A.* 6. *pp.* 417–427, *May*, 1932.—The tenacity coefficients of abnormal liquids are considered. The normal case for constant ζ-potential, and the variable ζ-potential are developed as a consequence of a "flow constancy" (*Fliessfestigkeit*) in the double layer. The thickness of the double layer and the strength of the layer were calculated for instances of abnormal tenacity. F. J. B.

4706. New Method of Estimating Cataphoretic Velocity in a Concentrated Suspension. S. Komagata. *Chem. Soc. Japan, Bull.* 7. *pp.* 137–143, *May*, 1932.—The author gives details concerning his newly devised procedure for estimating cataphoretic velocity by the weight method. It is shown that the results obtained coincide well with those obtained by the U-tube method. J. K.

4707. Method of Cataphoretic Measurements. A. J. Rabinowitsch and E. B. Fodiman. *Kolloid Zeits.* 59. *pp.* 310–314, *June*, 1932.—The conditions are determined so as to make possible exact and reproducible measurements of the cataphoretic velocity of colloid particles. To this end the results are given for measurements on ferric hydroxide and arsenic tri-sulphide sols, employing sols and dispersion fluids having various properties. To obtain clear-cut limiting conditions the conductivity of the dispersion fluid must be equal to, or higher than, that of the sol. The increase of conductivity of the dispersion fluid with reference to that of the sol lowers the cataphoretic velocity for increasing limits, and also causes reverse. The lowering of the pH value of the dispersion fluid with reference to that of the sol increases the cataphoretic velocity for increasing limits. From such data the best conditions for cataphoretic measurements are found. J. K.

4708. Debye-Hückel Theory and Electrophoresis. R. Audubert. *Comptes Rendus*, 195. *pp.* 210–212, *July* 18, 1932.—It is shown theoretically that according to the Debye–Hückel theory $(\psi_0 - \psi)/\psi$, where ψ_0 and ψ are the electrokinetic potentials at infinite dilution and concentration C respectively, should be proportional to $C^{0 \cdot 5}$, and this conclusion has been verified experimentally. The electrokinetic potential may therefore be calculated by employing the Debye–Hückel theory. H. F. G.

4709. Electrolysis of a Mixture of Two Fatty Acids. M. Matsui and S. Arakawa. *Kyoto Coll. Sci., Mem.* 15. *pp.* 189–194, *May*, 1932. *In English.*—When propionic acid is electrolysed together with a higher fatty acid, such as palmitic or stearic acid, a new hydrocarbon consisting of the alkyl radicals of both fatty acids is produced, in addition to the hydrocarbons formed in the electrolysis of the two acids separately. Moreover, the molecular proportions of the two hydrocarbons $C_{17}H_{36}$

and $C_{30}H_{62}$ formed from a mixture of propionic and palmitic acids is nearly the same as that of the two hydrocarbons $C_{16}H_{34}$ and $C_{30}H_{62}$ formed from a mixture of acetic and palmitic acids. It has been thought hitherto that the monochloracetic ion never yields the CH_2Cl radical, even momentarily, but decomposes at once into $CH_2O + CO + Cl$; it is now found that this ion behaves analogously to acetate and other fatty ions during electrolysis in presence of higher fatty acids. Doubt concerning the primary formation of the chloromethyl radical in the electrolysis of chloracetic acid is thus removed. Since ethylene chloride is not formed electrolytically, it seems that the chloromethyl radical undergoes oxidation more readily than polymerisation. The apparently different anodic reactions of various fatty acids may be attributed to the varying stability and chemical properties of the products of the primary anodic reaction, which is the same for all fatty acids. T. H. P.

4710. Electrochemistry of Iron. S. Bodforss. *Zeits. f. phys. Chem.* 160. *Abt.A.* 3–4. *pp.* 141–157, *June*, 1932.—The potential of iron in aqueous solutions at the ordinary temperature is a function of the concentration of the H-ions and of the anion, but it is uncertain whether ferro- or other ions exert influence in this direction. It is hence questionable if, in measurements of e.m.f. at iron electrodes in solutions of iron salts, the normal potential of iron has ever been observed; the various factors influencing the potential are discussed. T. H. P.

4711. Electromotive Behaviour of Iron. E. Müller and J. Janitzki. *Zeits. f. phys. Chem.* 160. *Abt.A.* 3–4. *pp.* 245–256, *June*, 1932.—With compact iron in its salt solutions the reversible potential is not established, as it is active only at charged positions. The potential is a limiting one, the dissolution of the ferrous ions at the charged points having the same velocity as the diffusion of the discharged H_2 from the non-charged regions. By scraping of the metal in neutral solution, this limiting potential may be raised to the reversible potential of the metal. In this way a value of at least $\epsilon_h = -0{\cdot}512$ volt is obtained; the value previously assumed to be correct in normal ferrous sulphate solution is $-0{\cdot}46$ volt. T. H. P.

4712. Concentration of Hydrogen Isotope, H^2, by Fractional Electrolysis of Water. E. W. Washburn and H. C. Urey. *Nat. Acad. Sci., Proc.* 18. *pp.* 496–498, *July*, 1932.—The hydrogen liberated at the kathode in the electrolysis of water may not contain the isotopes H^1 and H^2 in the same proportions as the water. This would be the case if the two isotopes have appreciably different normal electrode potentials, and if the diffusion and subsequent reunion processes of their ions are different. In this case the residual water would be enriched with respect to H^2. An experiment is at present in progress in which it is hoped to enrich a sample of water with respect to H^2 by electrolysis, a similar enrichment with respect to O^{18} may be expected. In the meantime the residual solutions from commercial cells in which water has been continuously electrolysed for two years have been examined. A definite increase in the percentage abundance of H^2 in these solutions has been spectrographically established. A decrease of about 8 % in the concentration of O^{18} is noted, but the method of estimation is not accurate enough for this to be of any significance. J. E. K.

4713. Electrolytic Valve Action and Electrolytic Rectifiers. E. Newbery. *Roy. Soc., Proc.* 137. *pp.* 134–145, *July* 1, 1932.—The kathode-ray oscillograph was applied to investigate the behaviour of various valve electrodes and rectifying electrodes. The following are the chief results obtained: (1) Valve action is due to the formation of an adherent insulating anodic film which is permeable to H ions, but not to the anions present. (2) Rectifying action occurs when such a film is not reducible by the electrolytic hydrogen produced on it, and is also unchanged by further anodic action. (3) The film responsible for the rectifying action of an aluminium electrode is the oxide only. Hydration of this oxide destroys its rectifying efficiency. J. J. S.

4714. Electrolytic Peltier Effect in the System, Ag|AgNO$_3$, Aq. E. Lange and T. Hesse. *Zeits. f. Elektrochem.* 38. *pp.* 428–442, *July*, 1932.—Thomson's relationships, $I/II^{\epsilon} = \frac{I/II^{\pi}}{T}$ and $\frac{dI/II^{\epsilon}}{dT} = \frac{I^{\sigma} - II^{\sigma}}{T}$, are applicable directly only to metallic or, more generally, non-electrolytic systems. With electrolytic systems, attention must be paid to the non-isothermal transport of matter occurring in the electrolysis. It is found that, in this case, Thomson's first equation persists unchanged, but that the second becomes $\frac{dI/II^{\epsilon}}{dT} = \frac{I^{\sigma} - II^{\sigma}}{T} + \frac{C_I - C_{II}}{F\,.\,T}$, where C_I and C_{II} are the molar heats of the substances transported when the current flows. The fact that the first relation cannot be regarded as proved for electrolytic systems depends possibly on the possibilities of error in former measurements of electrolytic thermo-forces (I) and electrolytic Peltier heats (II). To test the validity of the expression $\epsilon = \pi/T$, measurements have been made of the electrolytic Peltier heats of the system Ag|AgNO$_3$ under various conditions. Comparison of the results with the corresponding electrolytic thermal forces shows satisfactory agreement within the limits of experimental error. The dependence of the electrolytic Peltier heats on concentration and activity agrees with that calculated theoretically when simple assumptions as to the Q^*-values are made. T. H. P.

4715. Distribution of Silver and Sodium between Glass and Nitrate or Bromide Melts in a State of Equilibrium. A. Güntherschulze and O. Mohr. *Zeits. f. techn. Physik*, 13. 8. *pp.* 356–358, 1932. —When ground glass is fused with a mixture of NaNO$_3$ and AgNO$_3$, the Ag is very largely transferred to the glass when equilibrium is reached. From NaNO$_3$ melts of moderate Ag content it is possible, by a single treatment with a fair quantity of the glass, to remove almost the whole of the Ag from the nitrate. Glass containing 43 % of Ag was thus obtained. With mixtures of fused NaBr and AgBr, the migration of silver to the glass is virtually suppressed by the presence of very small quantities of NaBr. On electrolysis, sodium first passes from the fused salt into the glass and only after all the Na has been used up does the electrolytic migration of Ag to the glass occur. T. H. P.